PEDESTRIAN LEVEL WIND STUDY
CITY OF REGINA
REGINA, SASKATCHEWAN

Submitted to:
City of Regina, Planning Department
Regina, Saskatchewan

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Report 5821291

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1.0 INTRODUCTION

Morrison, Hershfield, Theakston & Rowan Limited (MHTR Ltd.) was retained by the City of Regina to conduct a pedestrian level wind study on the downtown area of the City of Regina. The objective of the study was to evaluate the existing wind environment in the downtown area and to determine the effects of several proposed developments. A description of the causes of adverse wind conditions and potential remedial solutions have been included in Appendix B.

2.0 PEDESTRIAN LEVEL WIND STUDY

2.1 General Discussion

A 1:500 scale model of the downtown area of the City of Regina, as shown in Figure 1, centred on Cornwall Street midway between Eleventh and Twelfth Avenues was constructed and included all buildings within a 575 metre radius of this centre. The model was instrumented with wind velocity sensors at 92 strategic locations around the downtown area. The model was constructed and built in accordance with downtown plans and photographs received at our office on March 16th, 1982, and included all design features likely to affect the wind flows at the pedestrian level.

During the course of our investigations, a visit to our Edmonton laboratory was made by Mr. Peter Davies and Mr. Om Sharma of the Regina Planning Department on June 3rd, 1982. The purpose of this visit was to demonstrate the use of our facilities and to view the results of our tests, with primary concern being the adverse wind conditions noted in the downtown area.

An open channel waterflume/wind simulator and a dye injection technique were used to visually assess the wind environment around the downtown area. The visual assessment was completed in order to choose the locations at which detailed wind speed measurements would be taken. The model was then tested in our boundary layer wind tunnel. Following these tests, a computer analysis of the test data provided information on the wind conditions around the proposed building. The results of this computer analysis were plotted with wind speed versus frequency of occurrence for each test location. These plots along with a detailed explanation of the computer analysis and the subsequent interpretation of the comfort criteria plots has been included in Appendix A. The location of the points at which wind speeds were measured are shown on Drawing 5821291 which is included in the pocket at the end of the report.

Two different configurations were examined during the testing. The first configuration was the downtown area as it presently exists, and the second configuration included the proposed Lorne Street Square Development at Eleventh Avenue and Lorne Street; the Bank of Montreal Building at the northwest end of Scarth Street Mall, the McCallum Hill Building at the southwest end of the Scarth Street Mall, and a building at the southeast end of the Scarth Street Mall. These buildings are shown on Drawing 5821291. The above-mentioned buildings were modelled according to drawings received December 11th, 1981. The building at the southeast end of the Scarth Street Mall was arbitrarily chosen to have the approximate dimensions of the Lorne Street Square Development for convenience and to show the effect of a building on this site.

The wind directions examined during this study were in decreasing order of frequency of importance: southeast, northwest, west-northwest, west, east-southeast, north-northwest and south-southeast. The above directions are based on wind measurements recorded at the Regina Airport over a 10 year period from 1957 to 1966. A wind rose showing the frequency and mean speed versus direction for Regina has been included in Figure 2. The sections which follow contain the details of our assessment of the pedestrian level wind environment in the downtown area of the City of Regina. In addition, appendices have been included to describe the basic principles of wind engineering (Appendix B) and guidelines for undertaking pedestrian level wind studies (Appendix C) in order to identify potential problems and to find satisfactory solutions to them.

2.2 Detailed Analysis of Test Results

2.2.1 Scarth Street Mall

The Scarth Street Pedestrian Mall in downtown Regina is the focus of pedestrian traffic in the city centre and therefore the level of wind activity is very important. In general, the Mall experienced a pedestrian wind environment which was comfortable for lounging for the summer season and comfortable for walking in the winter.

Point location 1 (Drawing 5821291) on Eleventh Avenue west of the Mall was subject to uncomfortable winter wind conditions at least once per week. Uncomfortable conditions were caused by winds which approach from the north-northwest unobstructed by the presence of any tall structures upwind.

Locations 2 through 6, located on Eleventh Avenue, at the north end of the Mall, experienced comfortable wind conditions suitable for lounging in the summer season, and

for standing in the winter. The addition of the proposed Bank of Montreal Tower at the corner of Eleventh Avenue and Scarth Street, raised the level of wind activity at location 3 due to the effect of prevailing southeast winds, and at location 6 as a result of east-southeast winds. However, these points remained comfortable for walking in the summer, but were uncomfortable for walking throughout the winter.

It was determined that the location of the proposed elevated walkway from the Bank of Montreal Building across Eleventh Avenue to the Canada Permanent Trust Building was critical to the local wind environment. Locating the pedestrian walkway at the northwest corner of the building increased wind activity beneath the bridge (location 1) for winds from the west. This increased wind activity was restricted to the area beneath the walkway, and the walkway had no effect on the wind environment in the Scarth Street Mall. The walkway was then relocated to the northeast corner of the Bank of Montreal Building and flows were re-examined in the waterflume. Wind activity was increased both under the relocated walkway (location 3) and in the Scarth Street Mall (locations 6 and 7). It is therefore recommended that the elevated walkway be located at the northwest corner of the proposed Bank of Montreal Tower.

On the Scarth Street Mall itself, locations 7 and 8, in the northern third of the Mall, were comfortable for both seasons, but were subject to significant increases when the proposed Bank of Montreal Building was placed on site. Point location 8 experienced the greatest change such that conditions became uncomfortable for walking occasionally during the summer and at least once per week in the winter. The unpleasant conditions were created by strong north-northwest wind flows that were channelled down the north face of the building and around the corner into the Mall.

Midway down the Scarth Street Mall, points 9 and 11 experienced a comfortable wind environment and were not significantly affected by the addition of the Bank of Montreal Building or the proposed McCallum Hill Building. Although conditions at point location 10, halfway down the mall, deteriorated with the presence of the additional building, conditions were still comfortable for walking in the summer. However, uncomfortable conditions for walking occurred in the winter. Southeast winds were downwashed from the face of the proposed McCallum Hill Building increasing street level flows in the Mall.

Point locations 12 through 15, at the south end of the Mall, experienced conditions which were comfortable for pedestrian activity in both the winter and summer seasons under the existing conditions. The addition of the proposed McCallum Hill Building, as well as

a building across the Mall, increased levels of wind activity for points 12 through 15. Although conditions remained comfortable for walking in the summer, winter conditions were made uncomfortable for walking at least once per week.

Point location 16, at the corner of Twelfth Avenue and Scarth Street, at the northeast edge of Victoria Park, experienced conditions comfortable for standing in summer and walking in winter under the existing conditions. A slight increase of wind activity was noted for both seasons with the introduction of the McCallum Hill Building. This increase was noted when winds were from the north-northwest. Directly across Scarth Street at point location 17, conditions were similar to point 16, however, no significant changes in the level of wind activity were noted when the McCallum Hill Building was introduced.

2.2.2 Hamilton Street

The wind activity along Hamilton Street was examined since it is an important pedestrian route. Generally, pedestrian level wind activity on Hamilton Street was higher than that found on the Scarth Street Mall. These higher levels of wind activity were due to the presence of taller buildings on the east side of Hamilton Street. Prevailing winds from the northwest quadrant hit these buildings and were forced down to pedestrian level. The addition of the proposed buildings on the Scarth Street Mall had no effect on Hamilton Street.

Wind from the southeast primarily contributed to the local wind environment at points 18 and 19 north of Eleventh Avenue. Point 18 was subject to uncomfortable conditions for walking of more than once per week for the winter season, whereas during the summer season, it experienced uncomfortable conditions for walking only once a month. Point location 19 was suitable for walking throughout the year.

At the intersection of Eleventh Avenue and Hamilton Street, points 20, 22 and 23 experienced a wind environment suitable for standing throughout most of the summer. During the winter season, conditions were more severe, occasionally displaying uncomfortable conditions for walking. Point location 21 was generally comfortable for walking throughout the summer season, however, northwest winter winds were severe at this location and created uncomfortable conditions for pedestrian use throughout the winter.

Points 24 and 25, along Hamilton Street between Eleventh and Twelfth Avenues, were pleasant for standing throughout most of the summer. This area was comfortable for walking during the winter.

Measurements recorded at locations 26 and 28 indicated a slight reduction in the level of wind activity with the introduction of the McCallum Hill Building, due to upwind protection from winds approaching from the northwest sector. Conditions at these points were comfortable for walking in the summer, but uncomfortable throughout the winter.

Locations 27, 29, 30 and 31, along Hamilton Street south of Twelfth Avenue, were subject to high velocity winds predominately from the west-northwest direction. These points were uncomfortable for walking much of the summer season and continuously uncomfortable for walking in the winter season.

2.2.3 Victoria Avenue

Victoria Avenue lies on the southern edge of the downtown area. It supports a moderate level of pedestrian activity due to the presence of the park immediately north of the street between Lorne and Scarth Streets. Point locations on Victoria Avenue between Cornwall Street and Hamilton Street, (locations 32 through 38 inclusive), experienced significant levels of wind activity. This area was not affected by the addition of the proposed developments.

Several points along Victoria Avenue were found to be uncomfortable for walking approximately once per week during the summer, and uncomfortable for walking throughout the winter. The area around the water fountain for the Saskatchewan Power Corporation Building (location 37) experienced uncomfortable conditions for walking once per week during the summer. The high level of wind activity observed explains why this fountain can only be used intermittently.

2.2.4 Victoria Park

Victoria Park occupies one city block in the southern section of downtown Regina. With the information supplied to us, it was not possible to accurately model the existing landscaping within the park. Therefore, the results of the study do not reflect the level of protection afforded by the trees and bushes in the park, particularly in the summer.

Regions within the centre of the park (locations 43, 44, 45 and 48) experienced conditions comfortable for walking in the summer, without accounting for landscaping. Conditions within the park would be suitable for lounging in several locations due to the presence of the existing landscaping. Conditions were suitable for walking throughout most of the winter.

The area around the perimeter of the park (locations 32, 39, 40, 46 and 49) experienced comfortable conditions for walking throughout most of the summer, however, conditions were uncomfortable for walking in the winter along Victoria Avenue.

2.2.5 City Hall

City Hall was examined since the plaza in front of it is know to experience uncomfortable winds. The area immediately in front of and to the east of the City Hall (point locations 50 to 53) experienced the highest levels of wind activity that were recorded in the City. This area experienced wind levels above the comfort criteria standard for occasional walking throughout the year and was influenced predominantly by winds from the northwest and west-northwest.

Locations 51 and 53 experienced extremely high levels of pedestrian wind activity. These areas were uncomfortable for pedestrian use at all times of the year, and experienced levels of wind activity dangerous to pedestrians on a monthly basis throughout the winter. The strong winds in this region were caused by undisturbed winds from the northwest quadrant being accelerated around the City Hall Building and drawn down to the plaza level.

The entrance to City Hall, location 52, was sheltered by the City Hall podium and thus experienced levels of wind activity lower than those points measured in the open space in front of the City Hall (location 51). The entrance experienced conditions uncomfortable for walking at least once per month during the summer and once per week during the winter.

Location 54, to the east of the City Hall, experienced acceptable levels of wind activity for walking in the summer, however, the level of wind activity was unacceptable at least once per week in the winter.

2.2.6 Twelfth Avenue

Twelfth Avenue was studied since it passes through the centre of the city, and thus supports pedestrian traffic. Twelfth Avenue between Smith and Cornwall Streets was influenced predominantly by winds from the northwest and experienced high levels of wind activity due to a lack of large structures upwind to provide protection from the prevailing winds.

The level of wind activity experienced was uncomfortable for walking between Smith and Lorne Streets for most of the winter. Some areas (locations 57, 59 and 62) also experienced unacceptable conditions on a weekly basis during the summer. Further to the east, at Cornwall Street (locations 63 and 64), conditions were comfortable for walking throughout the year. Location 64 was adversely affected by the addition of the McCallum Hill Building, but wind conditions remained acceptable.

2.2.7 Eleventh Avenue and Lorne Street

The intersection of Eleventh Avenue and Lorne Street is the location of the Saskatchewan Government Insurance (S.G.I.) Building which is currently the tallest structure in the city. The proposed Lorne Street Square Development will also be located at this intersection. This area was examined due to the presence of the above-mentioned buildings, to determine their effect on the local pedestrian level wind environment.

The area on the south side of Eleventh Avenue, just west of Lorne Street (location 75), experienced comfortable conditions for walking throughout the year. The addition of the proposed Lorne Street Square Building actually lowered the level of wind activity at that location.

The area surrounding the intersection (locations 76, 77, 78, and 81) experienced conditions that were generally comfortable for walking throughout the summer, but uncomfortable for walking on a weekly basis during the winter. This area experienced significant increases in the level of wind activity with the introduction of the proposed Lorne Street Square Development. Conditions with the proposed building on-site were uncomfortable for walking throughout the year. Winds from the northwest quadrant were re-directed down the north face of the building to pedestrian level, causing increased wind activity.

Locations 79 and 80, on the west side of Lorne Street immediately south of Eleventh Avenue, experienced conditions comfortable for walking throughout the summer and most of the winter before the addition of the Lorne Street Square Development. The addition of the development increased wind activity in the area. Conditions remained comfortable for walking for most of the summer, however, conditions were uncomfortable for walking on a weekly basis throughout the winter.

It should be noted that, although significant wind speed increases were recorded with the addition of the proposed Lorne Street Square Development, many locations could be

improved with a detailed study of the development. Changes would include strategically placed landscaping and minor alterations to the building, such as the addition of canopies.

The northeast corner of Eleventh Avenue and Lorne Street, (locations 85 and 86), experienced high wind activity. Winds from the northwest quadrant were deflected by the west face of the S.G.I. tower down to pedestrian level and west along Eleventh Avenue. Conditions near the corner were uncomfortable for walking on a weekly basis throughout the summer and winter. Further to the east (location 84), conditions were comfortable for walking during the summer, but uncomfortable in the winter at least one day per week. The addition of the Lorne Street Square Development had no significant effect.

2.2.8 Saskatchewan Drive at Lorne Street

The area around Saskatchewan Drive and Lorne Street is on the northwest edge of the city centre and is exposed to strong winds from the northwest quadrant. This area was not protected by any significant buildings upwind and prevailing north-northwest and northwest winds created increased pedestrian level wind activity.

This region (locations 87 to 92) experienced conditions which were comfortable for walking during the summer, but frequently uncomfortable for walking throughout the winter. This region was not significantly affected by the addition of any of the four proposed developments tested.

2.2.9 Other Areas

In general, testing revealed higher levels of wind activity along streets which run east-west versus those that run north-south. The vast majority of areas not previously discussed experienced conditions that were comfortable for walking throughout the summer, although some areas experienced uncomfortable conditions for walking during the winter.

3.0 SUMMARY AND DISCUSSION

The City of Regina is subject to prevailing winds that are 30% to 50% higher than winds in other major Canadian cities, including Vancouver, Calgary, Edmonton, Toronto and Montreal. The result is a potentially uncomfortable wind environment caused by buildings of moderate height. Currently, there are relatively few tall buildings in the

city, but areas of high wind activity are present around these buildings. As development continues, there is a potential for creating an unpleasant wind environment in the downtown area.

The present study was undertaken to evaluate existing conditions in the downtown area of Regina, to determine the effects of several proposed developments and to provide guidelines for development of the downtown area to maintain the wind environment at an acceptable level. Several areas within downtown Regina were examined including the Scarth Street Mall, Hamilton Street, Eleventh Avenue, Victoria Park and City Hall.

The Scarth Street Mall currently experiences comfortable wind conditions suitable for pedestrian lounging in the summer and walking in the winter. Proposed developments at the north and south ends of the Mall will increase wind activity along the Mall unless corrective measures are taken. It is recommended that major developments in the downtown area be studied to determine their effects on the wind environment. When potential problems are identified at an early stage, corrective measures can easily be incorporated into a design. Landscaping and minor changes can be added to improve conditions after construction, but this is not as effective. With care and planning, the comfortable environment on the Scarth Street Mall can be maintained while development continues around it.

The placement of elevated pedestrian level walkways should be considered carefully since they can create localized areas of high wind activity. A walkway extending north across Eleventh Avenue from the new Bank of Montreal Building was tested in two different locations. When the walkway extended from the northeast corner of the building, it had a significant adverse effect on the wind activity at the north end of the Scarth Street Mall. By locating the walkway at the northwest corner of the building, the area of disturbance was reduced and the Mall was unaffected.

Wind activity along Hamilton Street was found to be higher than the Scarth Street Mall because of the presence of taller buildings. However, the addition of the four proposed buildings that were modelled to the west provided some protection from the northwest winds and resulted in a slight reduction of wind activity at pedestrian level. The street is currently comfortable for walking in the summer, but frequently uncomfortable in the winter. Since Hamilton Street is a major pedestrian route, care should be taken to determine the effects of any large developments on the wind environment along Hamilton Street and to take corrective action when necessary.

Eleventh Avenue experiences wind activity similar to that on Hamilton Street, i.e., comfortable for walking in the summer, but frequently uncomfortable in the winter. The intersection of Lorne Street and Eleventh Avenue was frequently uncomfortable for walking in the summer because of the existing tall tower and some locations were made less comfortable with the addition of the proposed Lorne Street Square Development. Local conditions could be improved by examining the flow conditions in detail and developing solutions in the form of minor architectural features and landscaping.

Victoria Park was shown to be comfortable for lounging in the summer and walking in the winter. Proposed developments adjacent to the park that were tested had little effect, but future projects should be examined for adverse effects on the wind environment in the park.

The plaza in front of City Hall experienced the highest levels of wind activity in the city and was uncomfortable for walking in both the winter and summer. This high wind activity was caused by undisturbed northwesterly flows that passed over the podium and around the tower and were drawn down into the plaza area. Extensive development to the northwest of the site would reduce wind levels and extensive landscaping using dense coniferous plantings and windscreens would aid in reducing wind activity in the plaza.

Future development in all areas of downtown Regina should be designed to minimize wind effects on the pedestrian environment. A description of flow characteristics around buildings and the types of solutions that can help reduce wind activity is given in Appendix B. A description of testing procedures and when they should be used to identify wind problems around proposed developments is given in Appendix C.

The City of Regina is subject to strong wind conditions and is therefore sensitive to changes in the wind environment. Existing conditions are acceptable throughout most of the downtown area, but some local areas of high wind activity are present. Careful consideration of wind in the design of future projects will help to maintain a suitable environment for pedestrians in downtown Regina.

MORRISON, HERSHFIELD, THEAKSTON & ROWAN, LIMITED

J.T. Templin, P.Eng.,
Manager of Wind Engineering

D.J. Halcrow,
Project Engineer

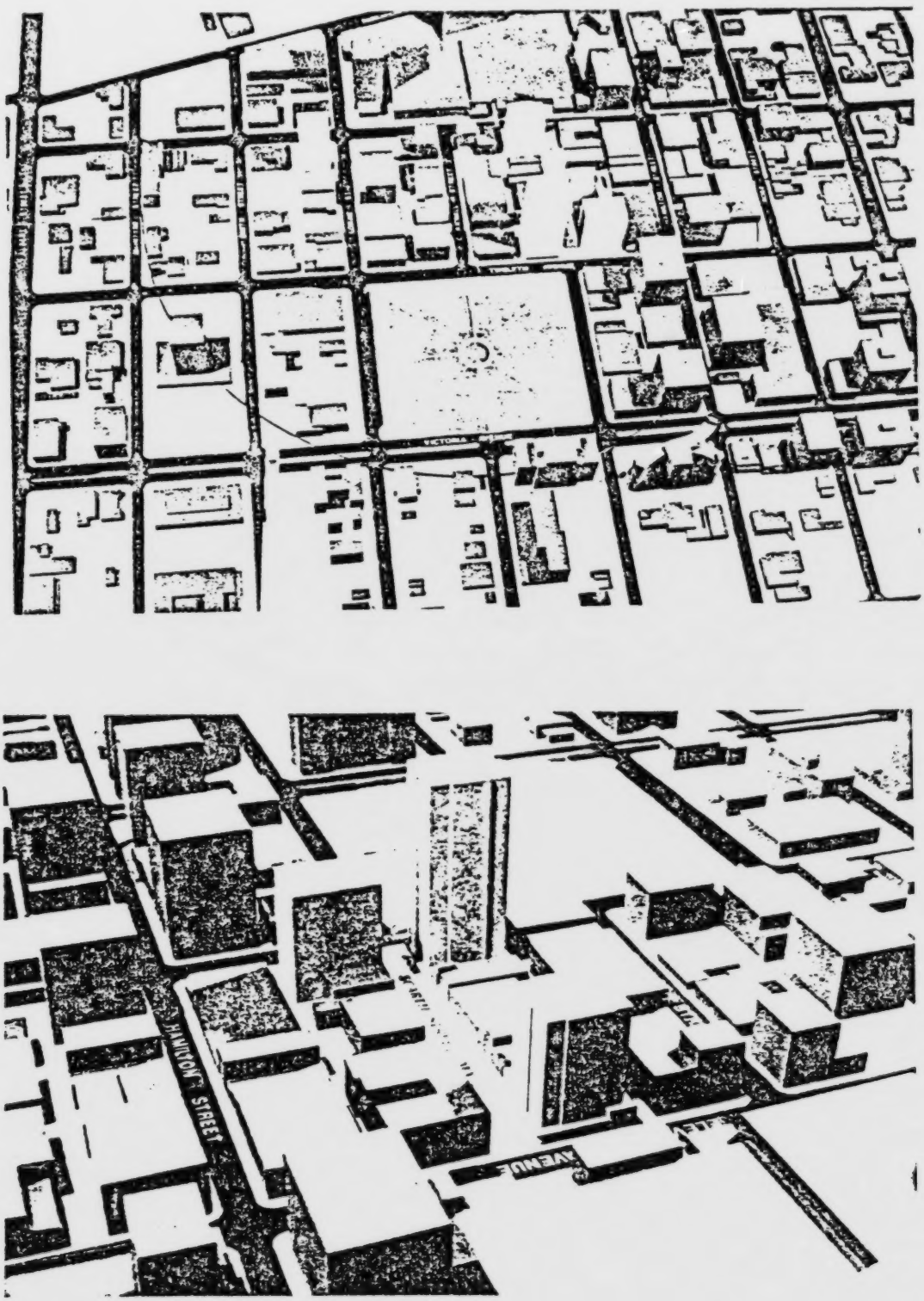


FIGURE 1

MODEL OF DOWNTOWN REGINA
INCLUDING PROPOSED DEVELOPMENTS

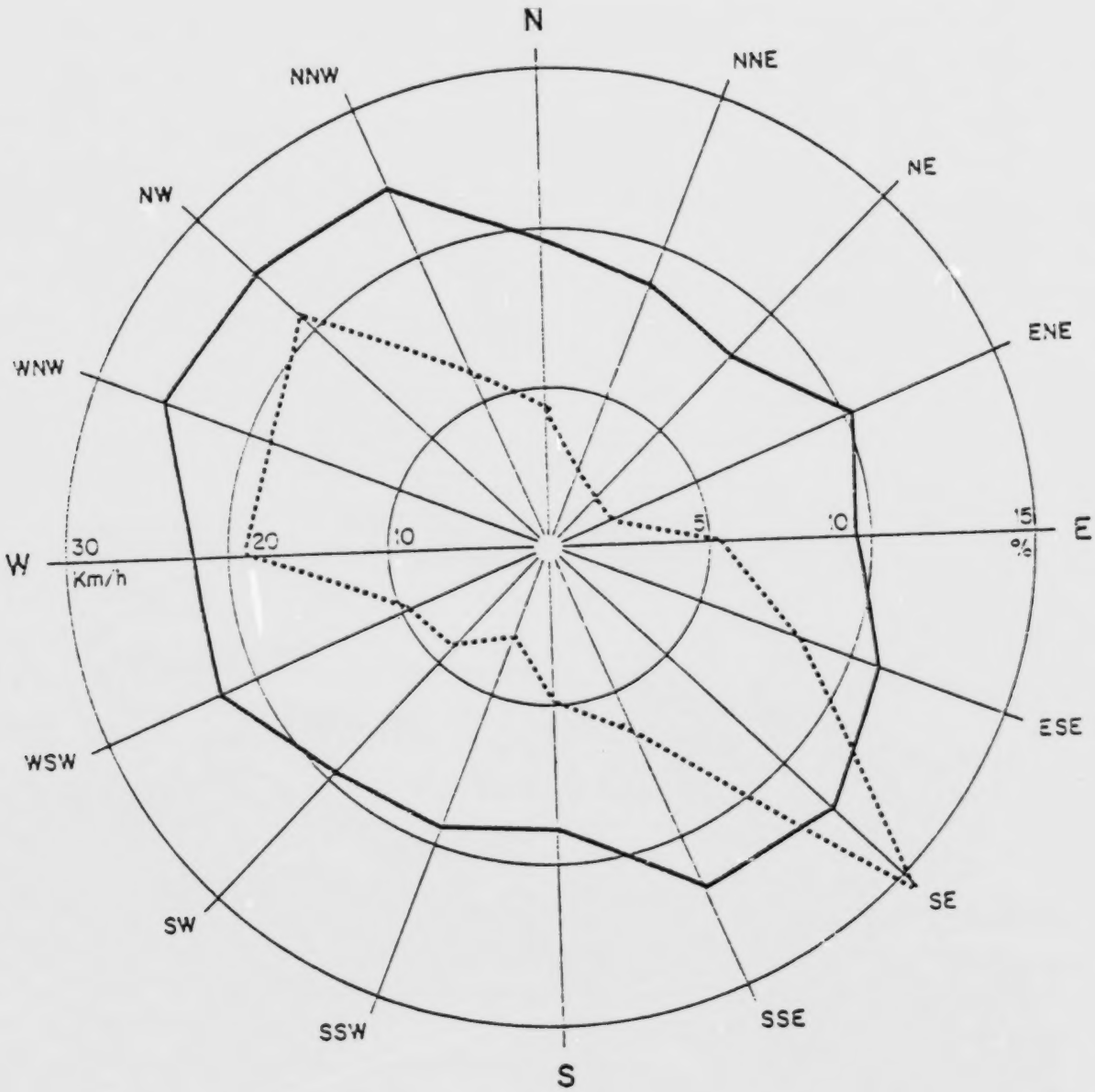


FIGURE 2

WIND DIRECTION, FREQUENCY AND MEAN VELOCITY
FOR REGINA INTERNATIONAL AIRPORT
ANNUAL DATA 1955—1966

APPENDIX A

Pedestrian Level Wind Test Data

SEASONAL COMFORT CRITERIA ASSESSMENT

Scale model measurements of pedestrian level wind speeds, together with meteorological data for the site, are used for predicting the frequency of occurrence of wind speeds at certain locations around the proposed building. The likelihood of winds occurring varies with wind direction and season, and this is used in the analysis to weigh the test results from each wind direction so that the end result is a realistic estimate of wind speeds to be expected. The resulting wind speed probability distribution for each location is compared graphically to a set of activity criteria for each particular season. The point location is then judged on its acceptability for the anticipated use of the area.

The acceptability criteria for various activities are indicated by the shaded lines on the graphs accompanying this appendix. The top graph on the figure shows the acceptability criteria selected for the summer months. An example of the interpretation of these criteria is that for walking a weekly mean wind speed occurrence of approximately 16 km/h with gusts up to 32 km/h; a monthly occurrence of 24 km/h with gusts up to 48 km/h; and a seasonal occurrence of approximately 30 km/h with gusts up to 60 km/h are considered acceptable. The wind speeds considered acceptable for the other activities noted on this figure can be obtained by referring to the relevant location on the vertical axis for various frequencies of occurrence.

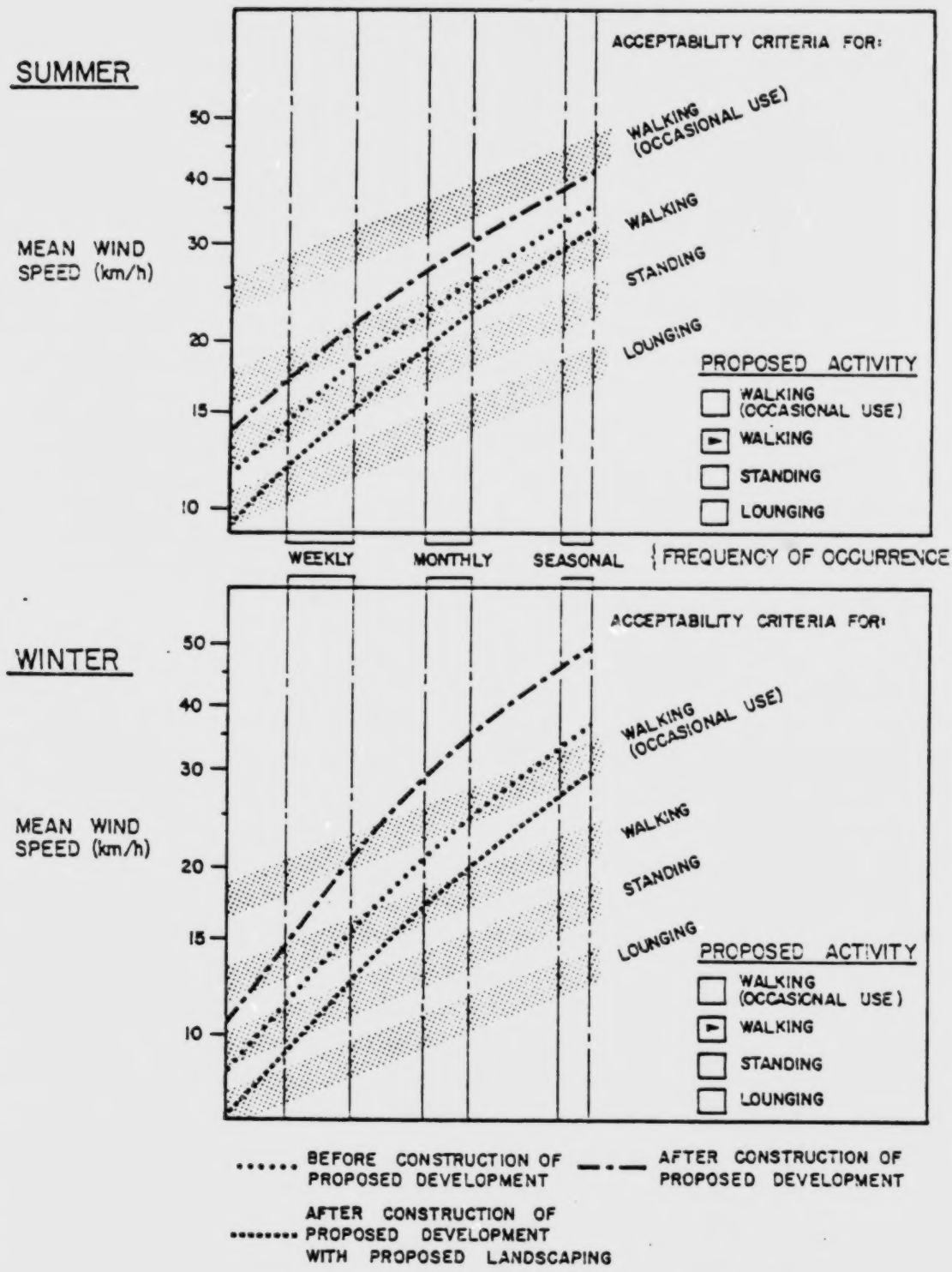
For the winter months the acceptance criteria are naturally more severe due to the effects of wind chill at low temperatures. As shown on the lower graph on the first figure, the acceptability criteria for walking now becomes a weekly occurrence of approximately 13 km/h (26 km/h gusts), a monthly occurrence of 18 km/h (36 km/h gusts) and a seasonal occurrence of 20 km/h (40 km/h gusts) which should not be exceeded.

On the graphs accompanying this appendix are examples of comparisons of the wind conditions at point location 'x' on a hypothetical site with the above acceptance criteria. The actual wind conditions which occur at location 'x' during the summer months before and after construction of the building are shown on the top graph of the figure. Pedestrians will be walking and not lounging in this area, and therefore the existing conditions are acceptable. After the building is constructed, the conditions will become less comfortable but are still in the acceptable range, however the addition of solutions reduces the wind velocities below the existing levels during the summer months. Pedestrians walking in this location during the winter months will experience uncomfortable conditions both before and after construction of the building as shown on the lower

plot on the first figure. The effect of adding the building is to increase the weekly occurrence of wind speeds from approximately 13 km/h to 18 km/h and therefore it is considered that the building has not significantly affected the existing conditions. Once again the addition of solutions reduces the wind velocities below the existing wind levels.

Similar interpretations of various locations examined in this study are given in the summary in the main body of the report.

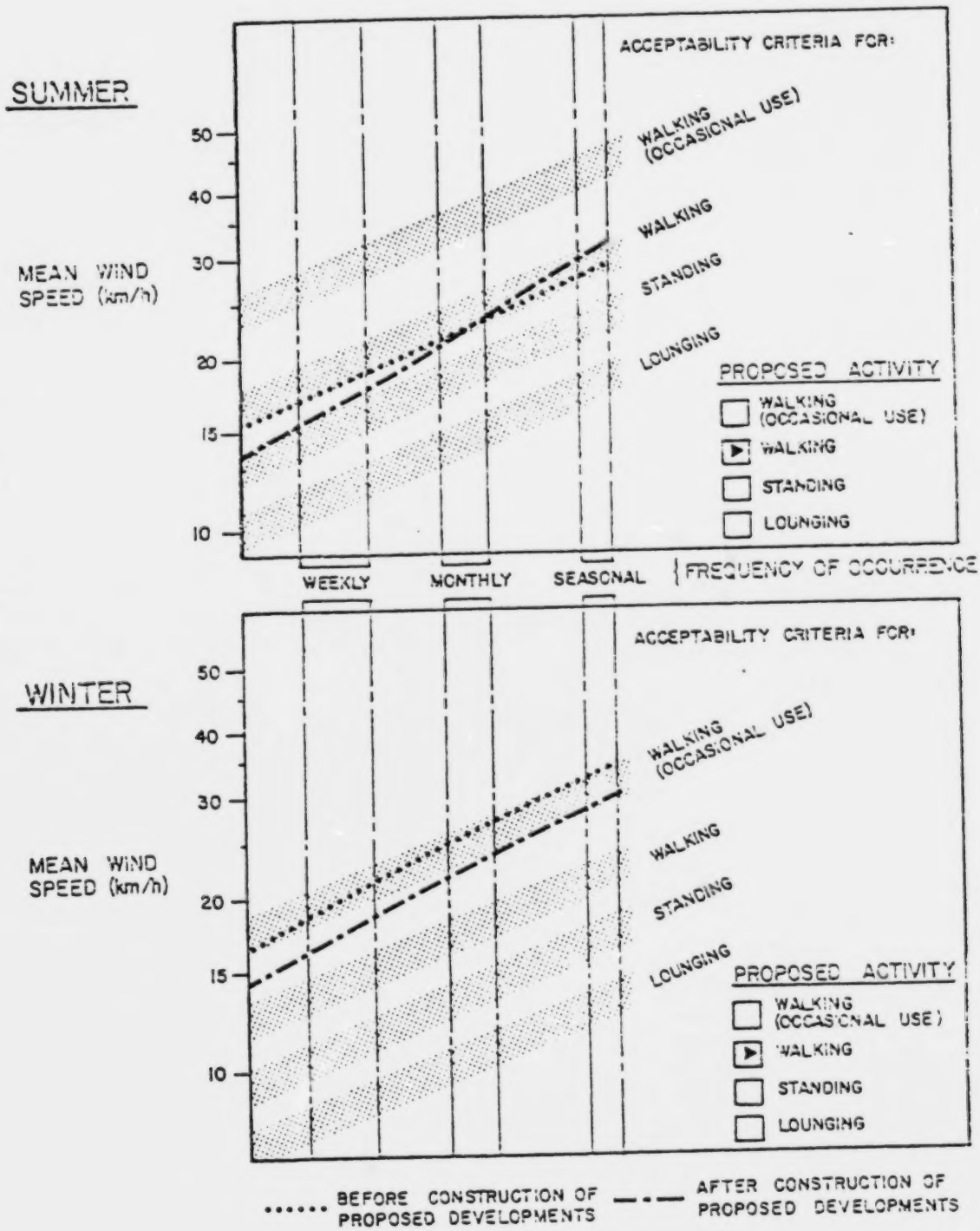
MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (X)



NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

GRAPHIC PRESENTATION OF TEST RESULTS

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (1)



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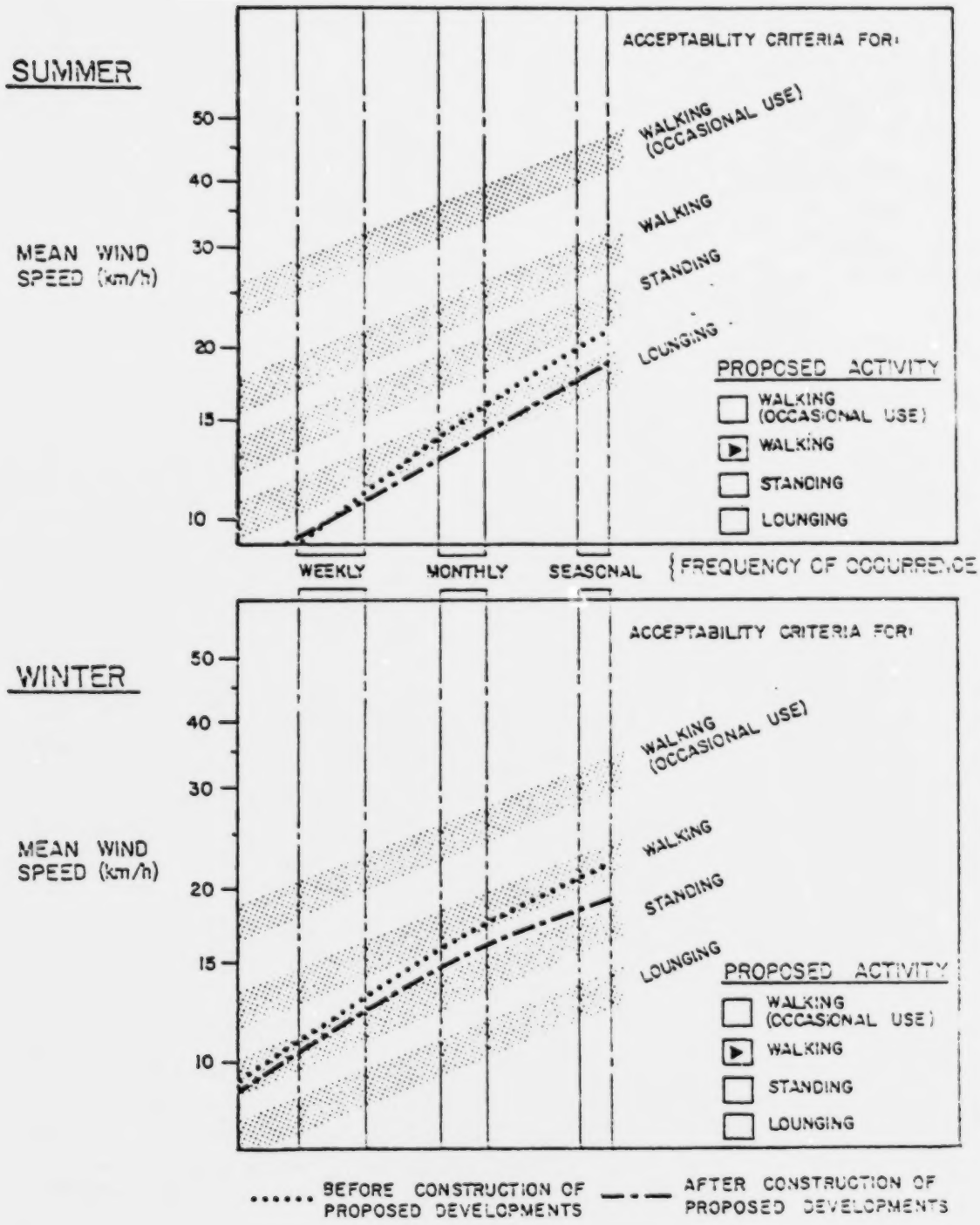
MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (2)



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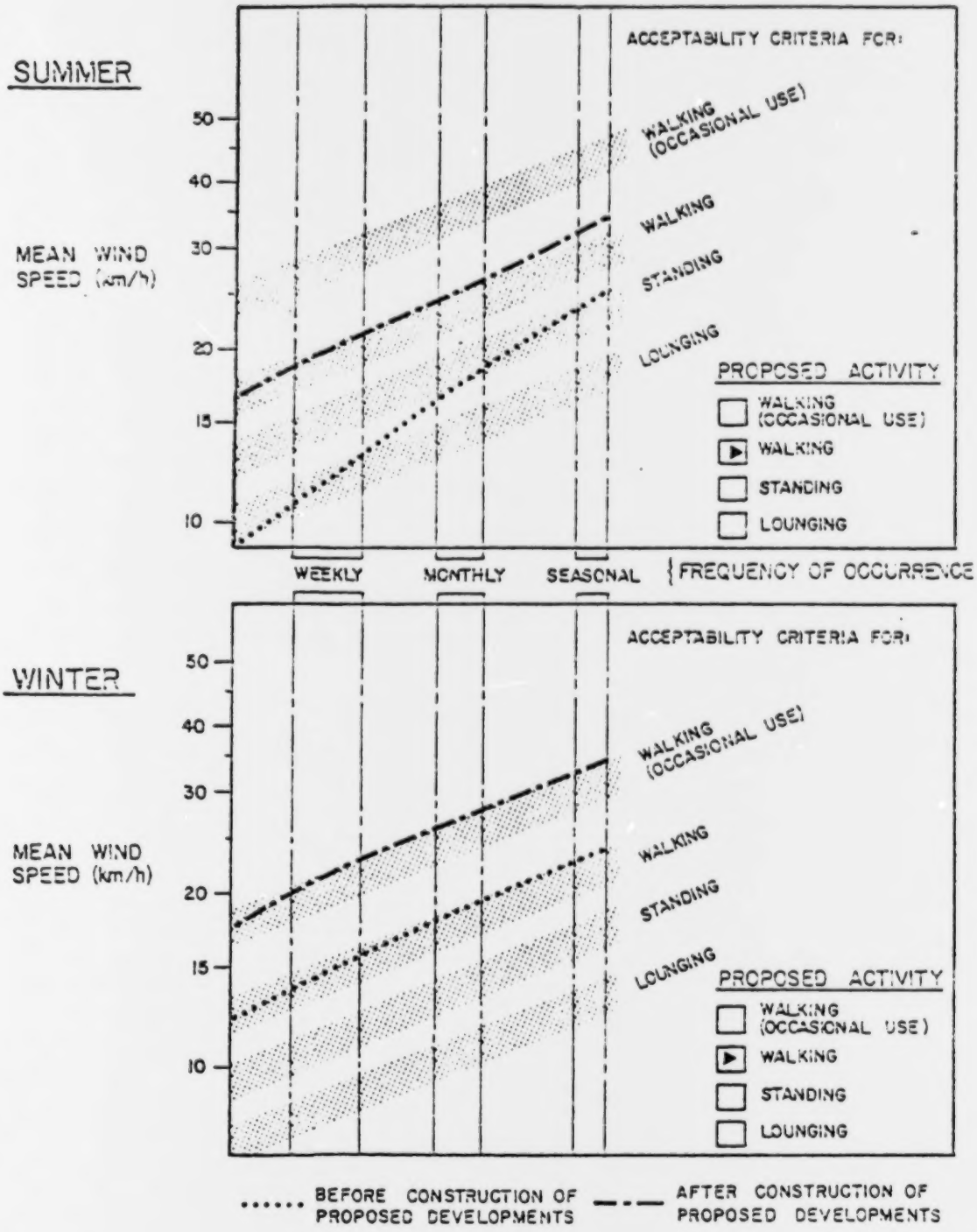
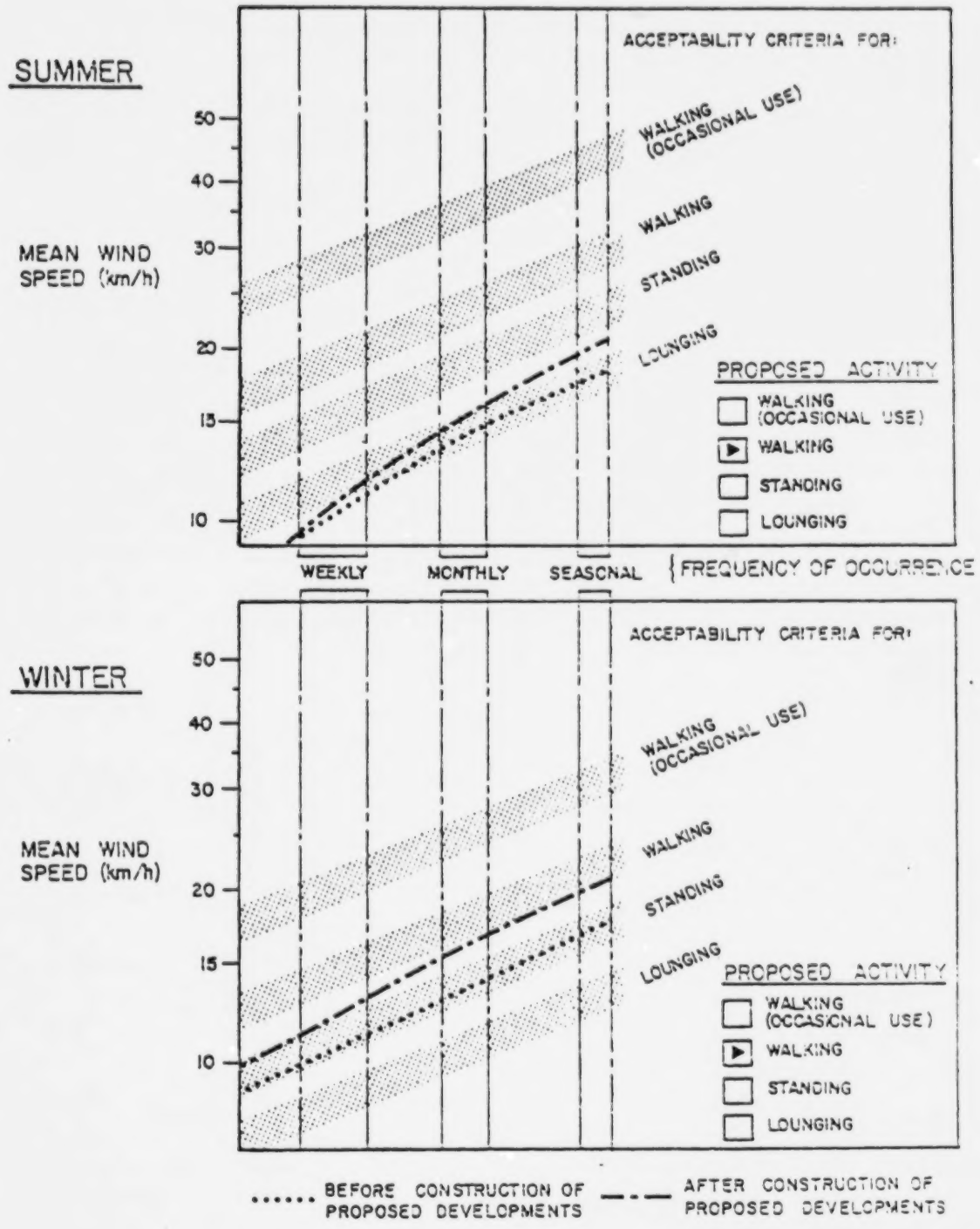
MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (3)



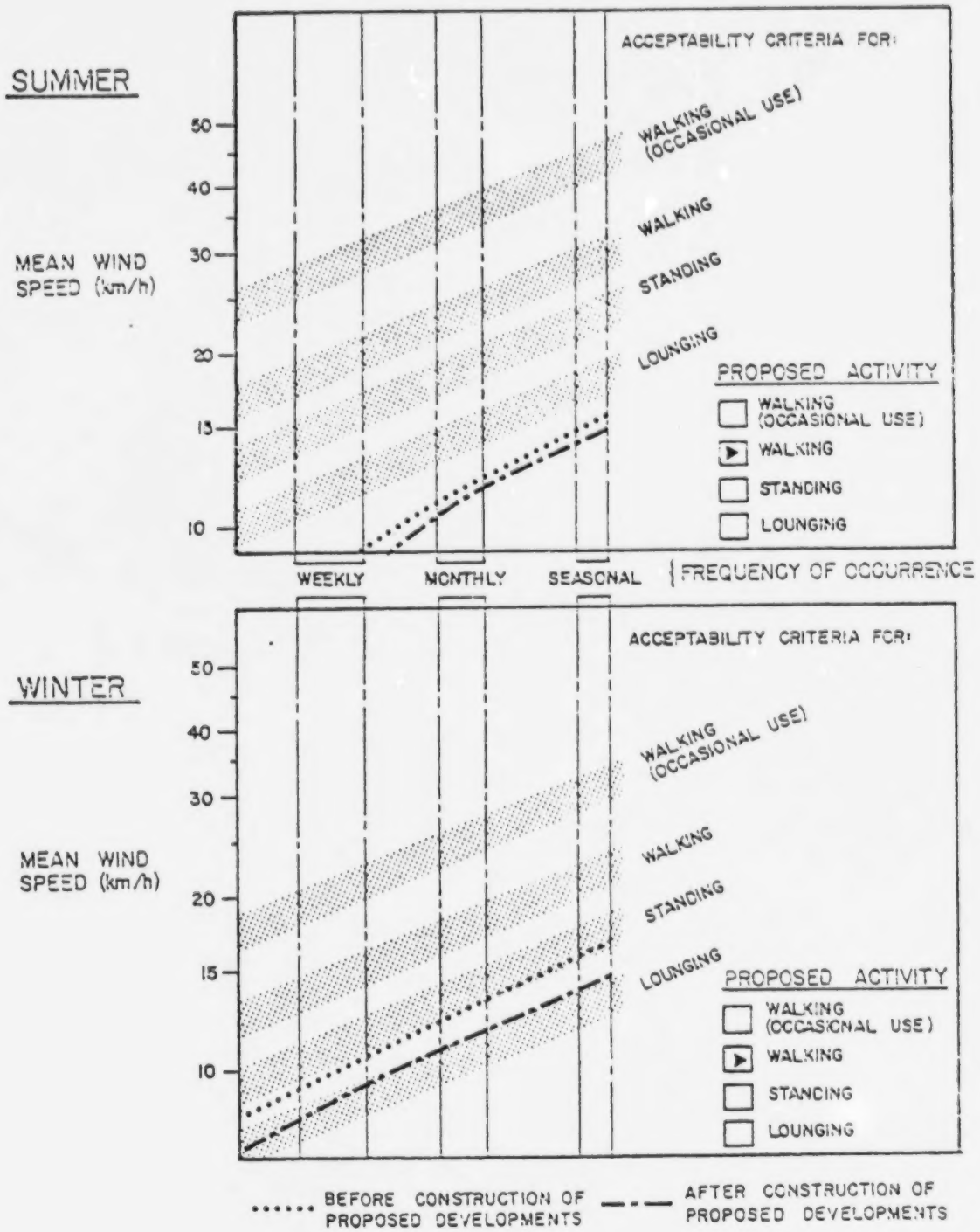
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (4)



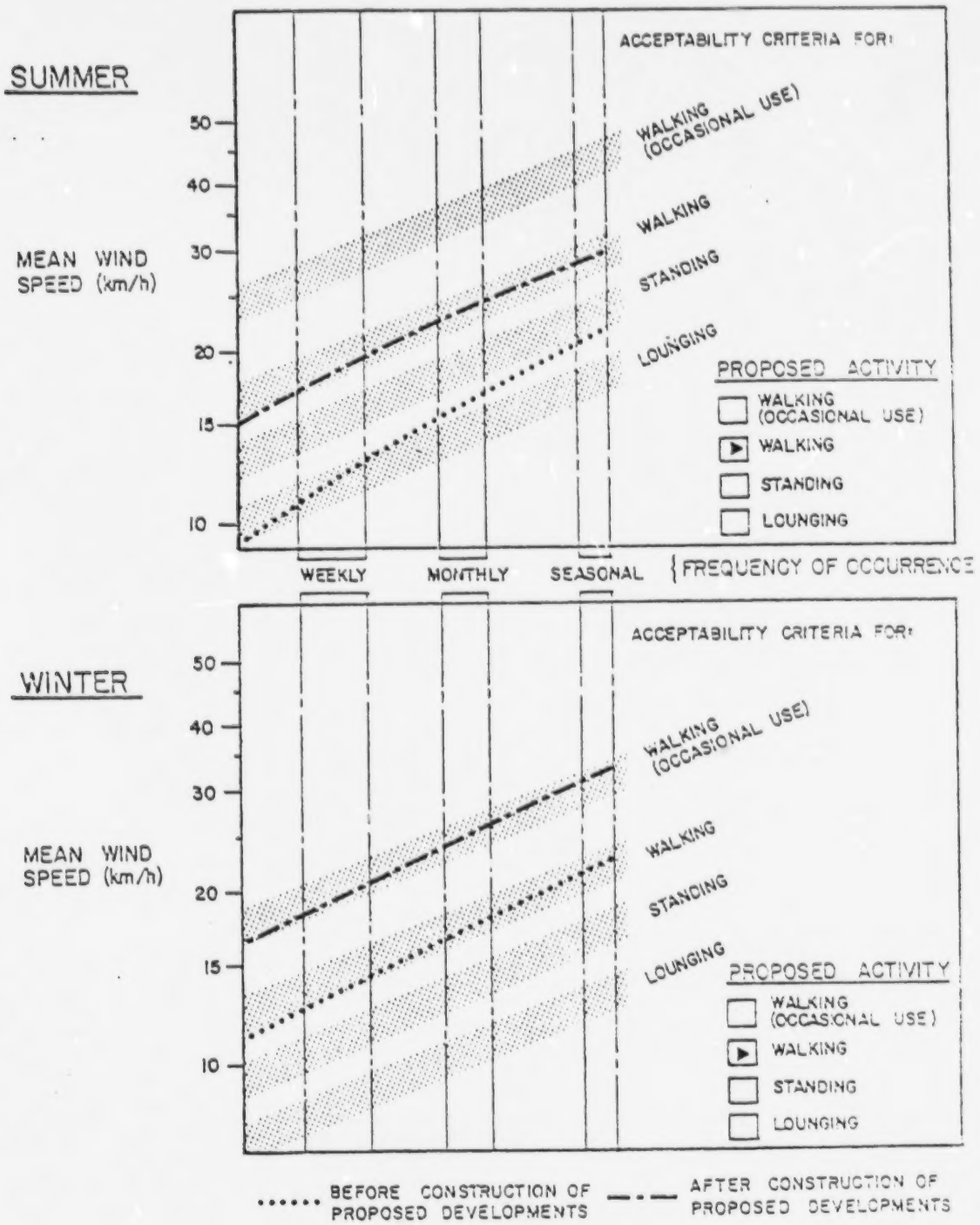
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (5)



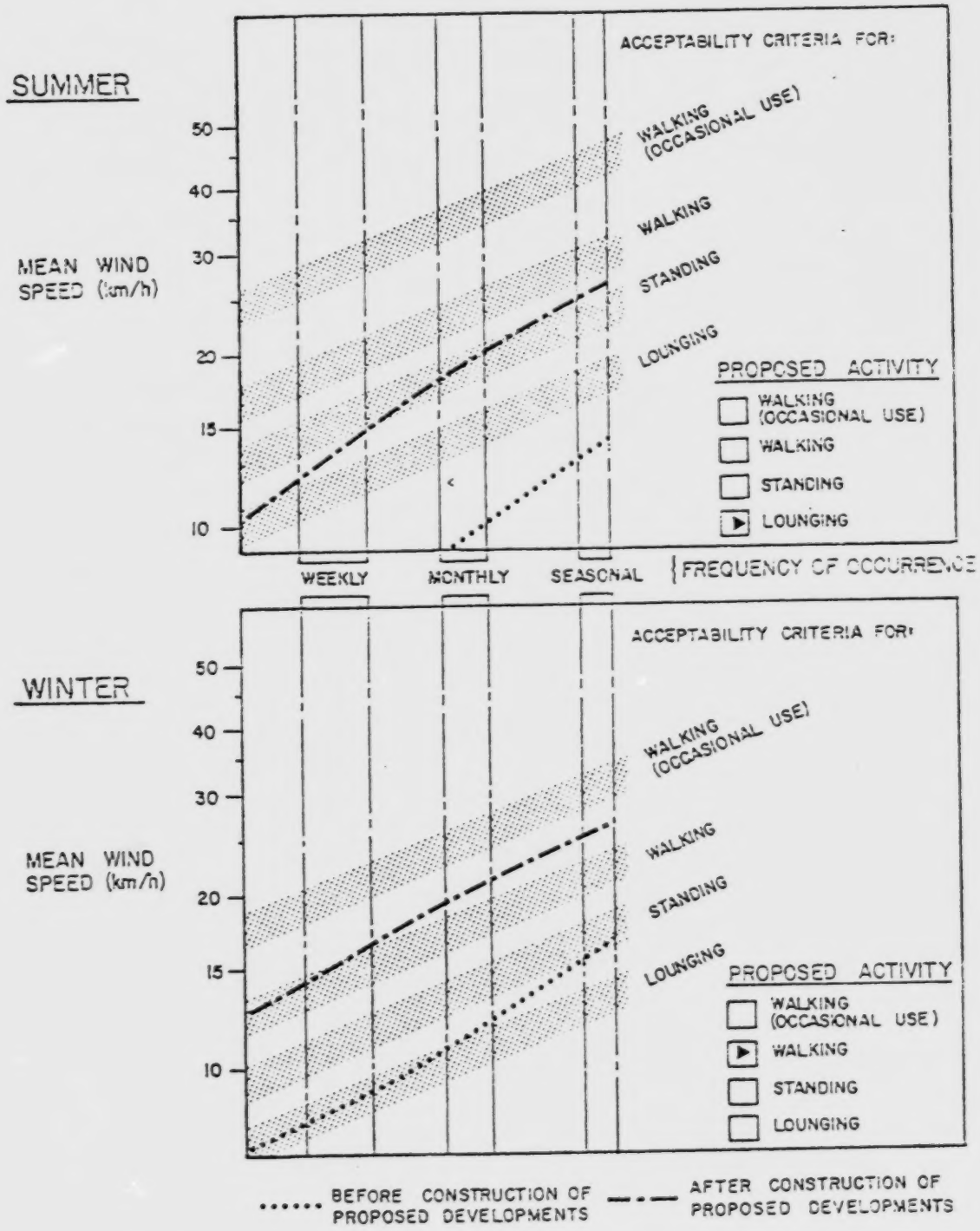
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (6)



NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (7)



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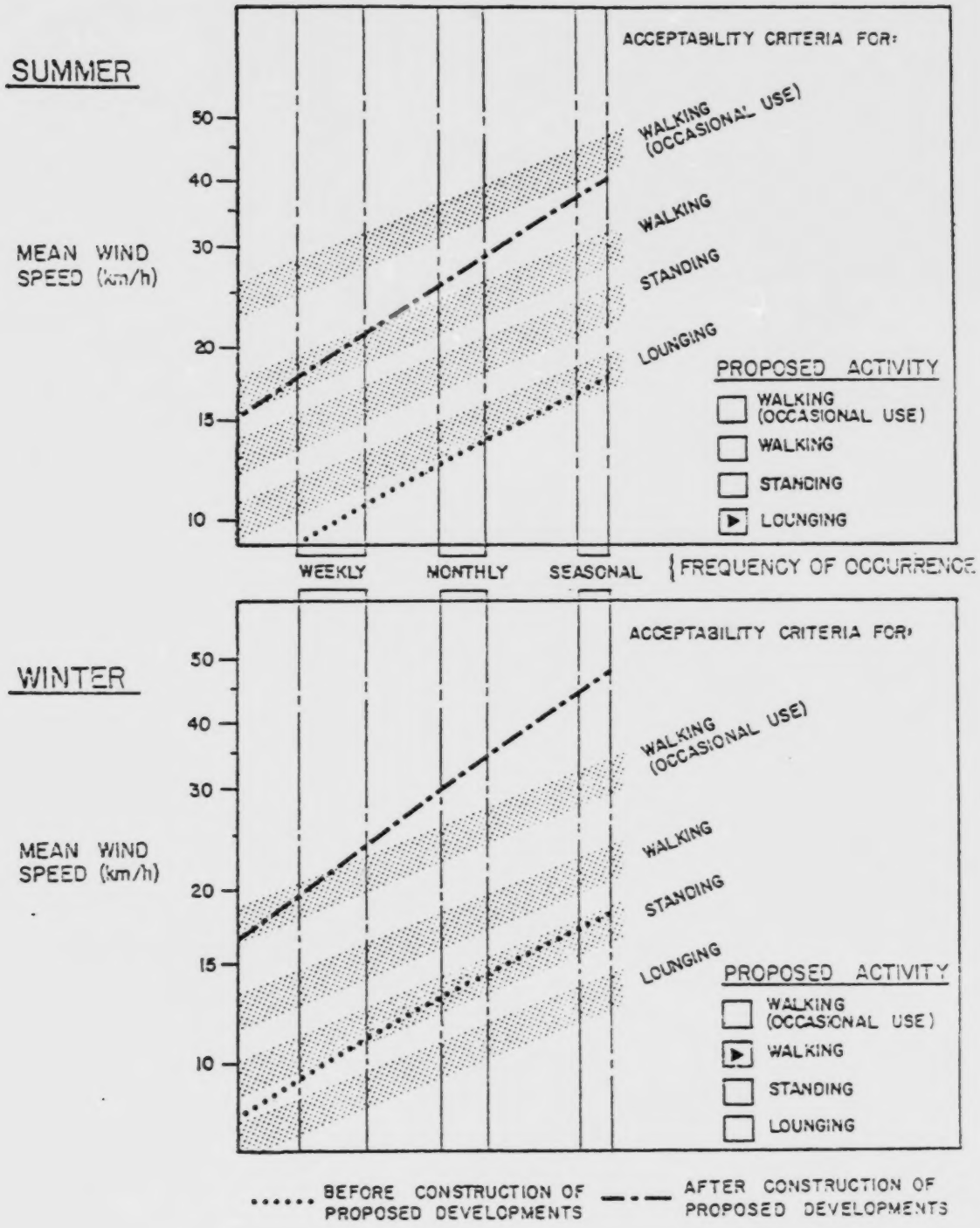
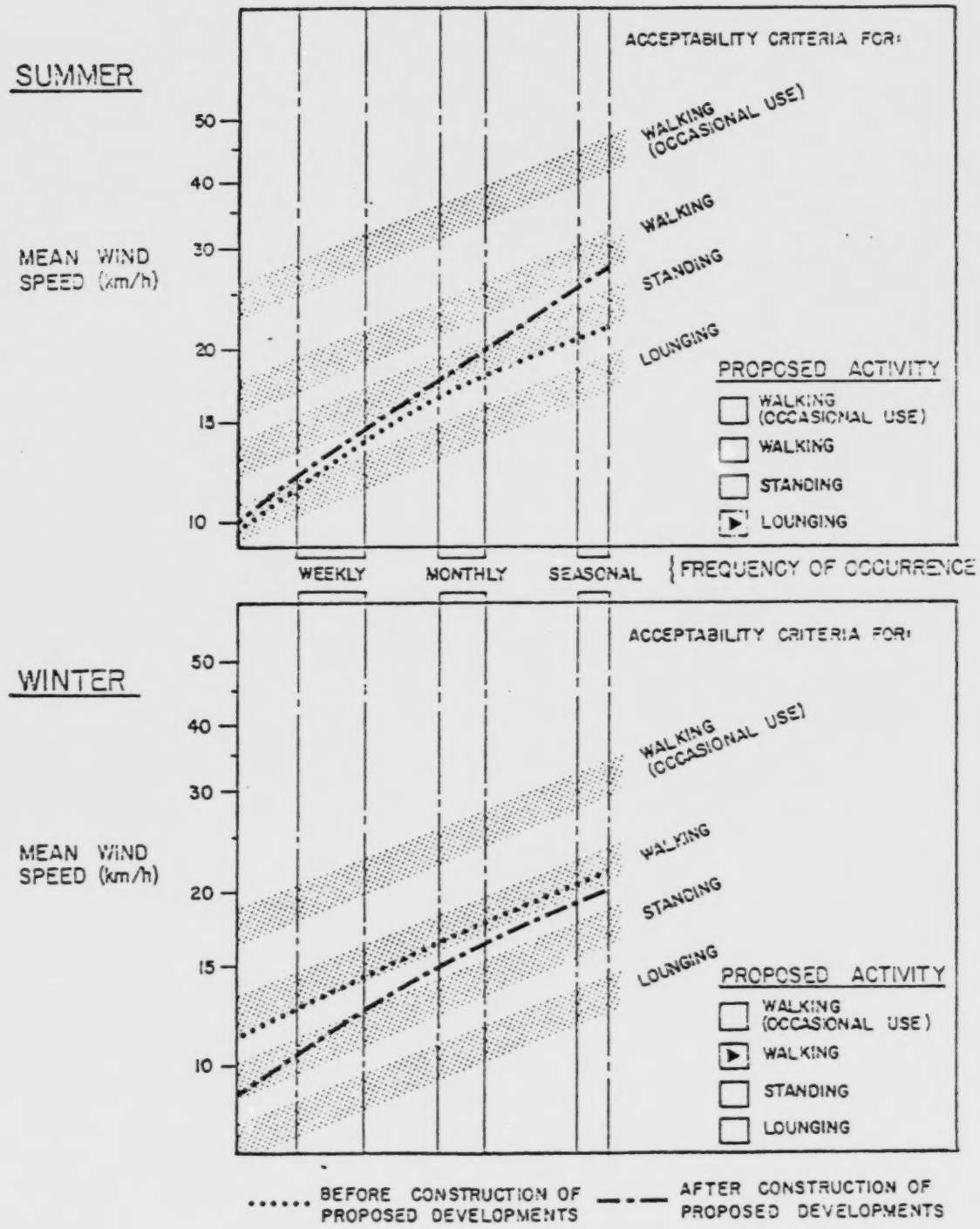
MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (8)



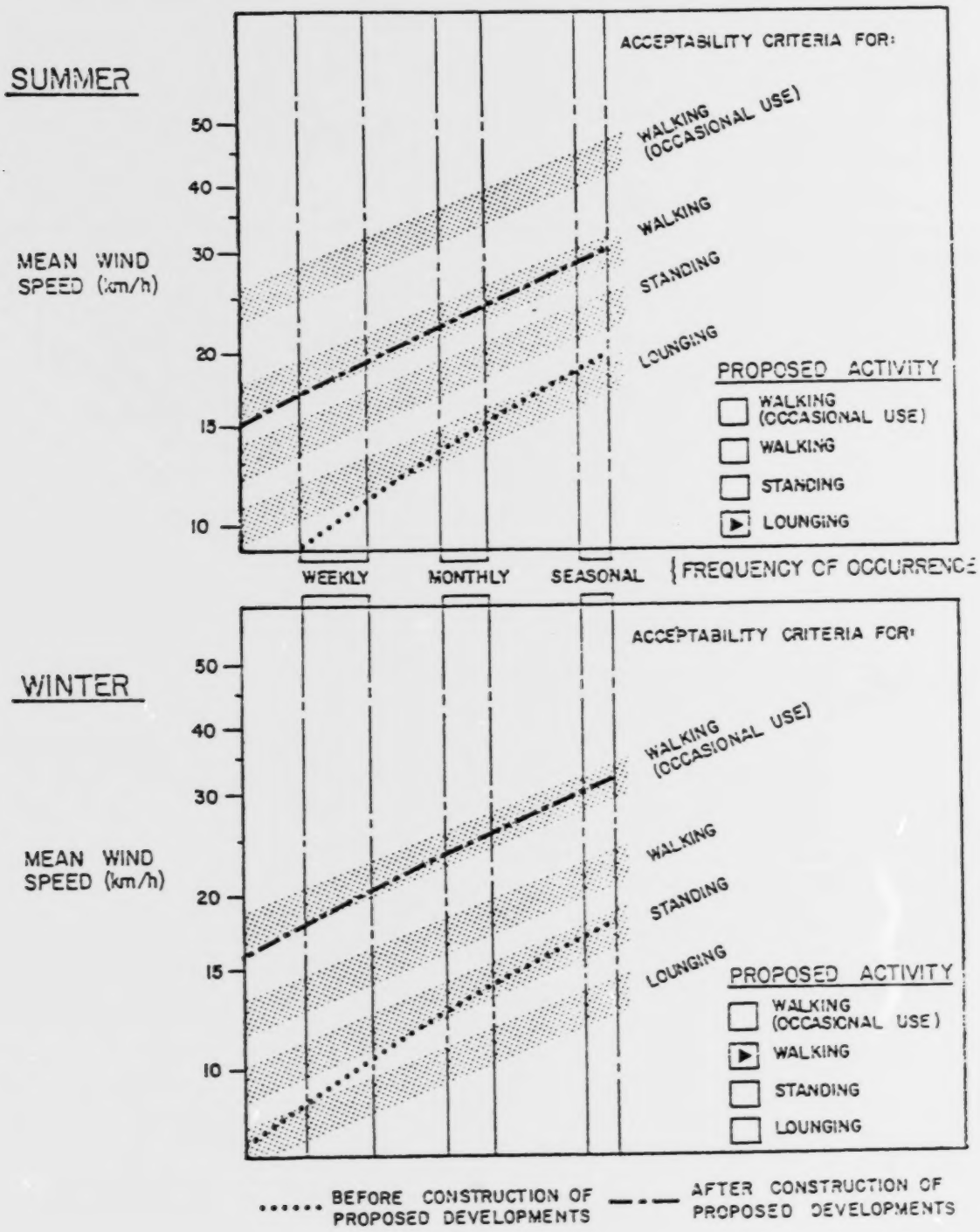
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (9)



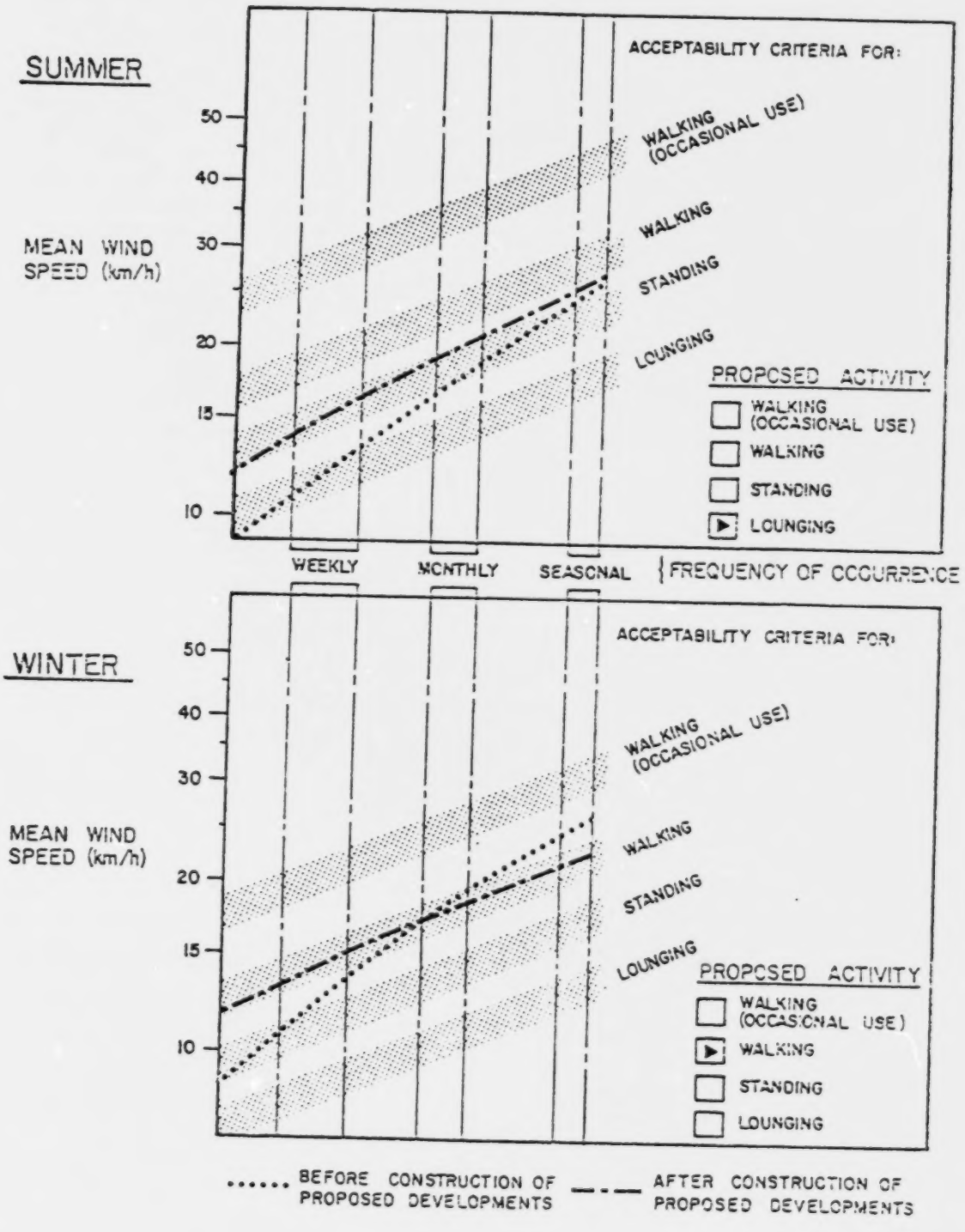
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (10)



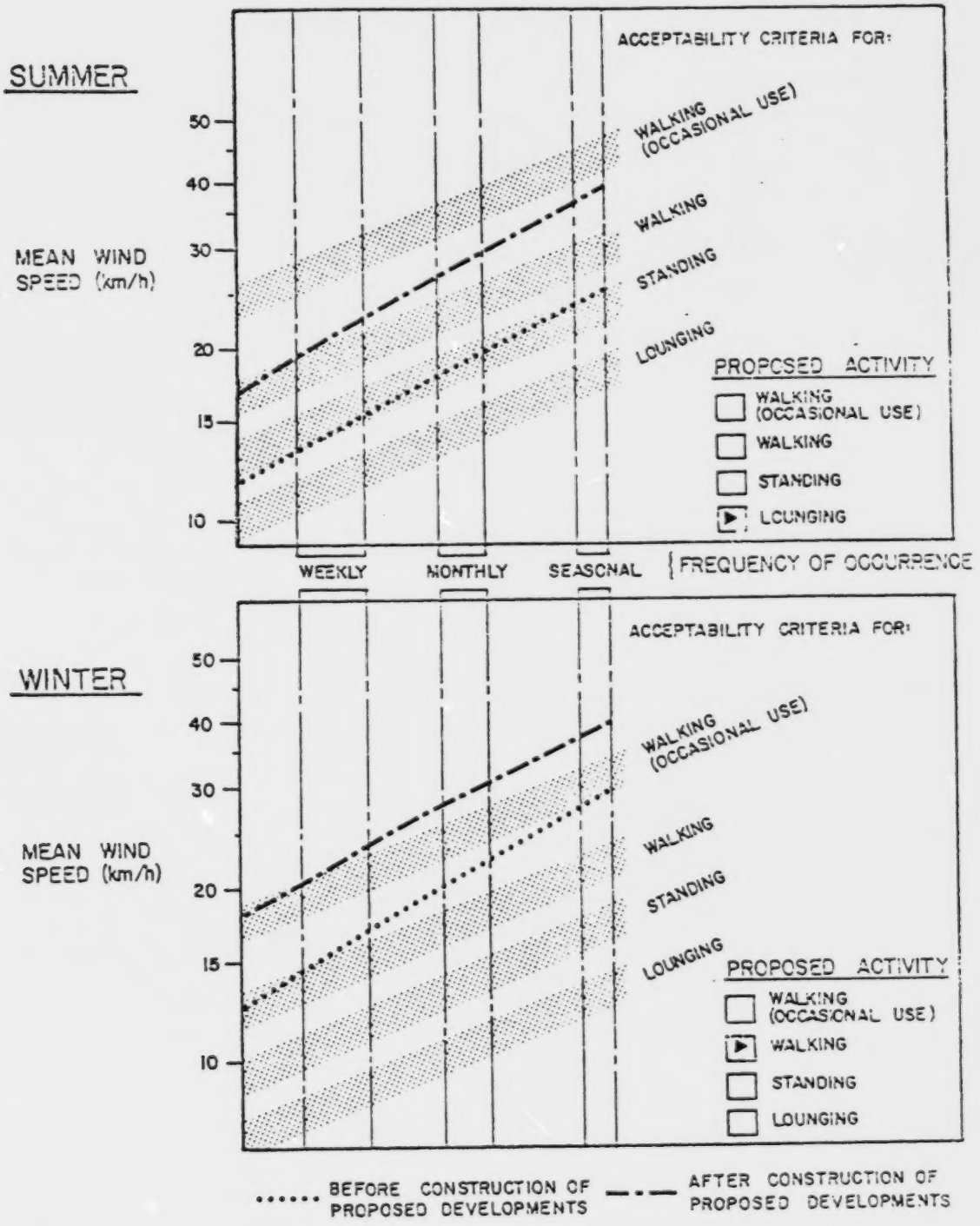
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (11)



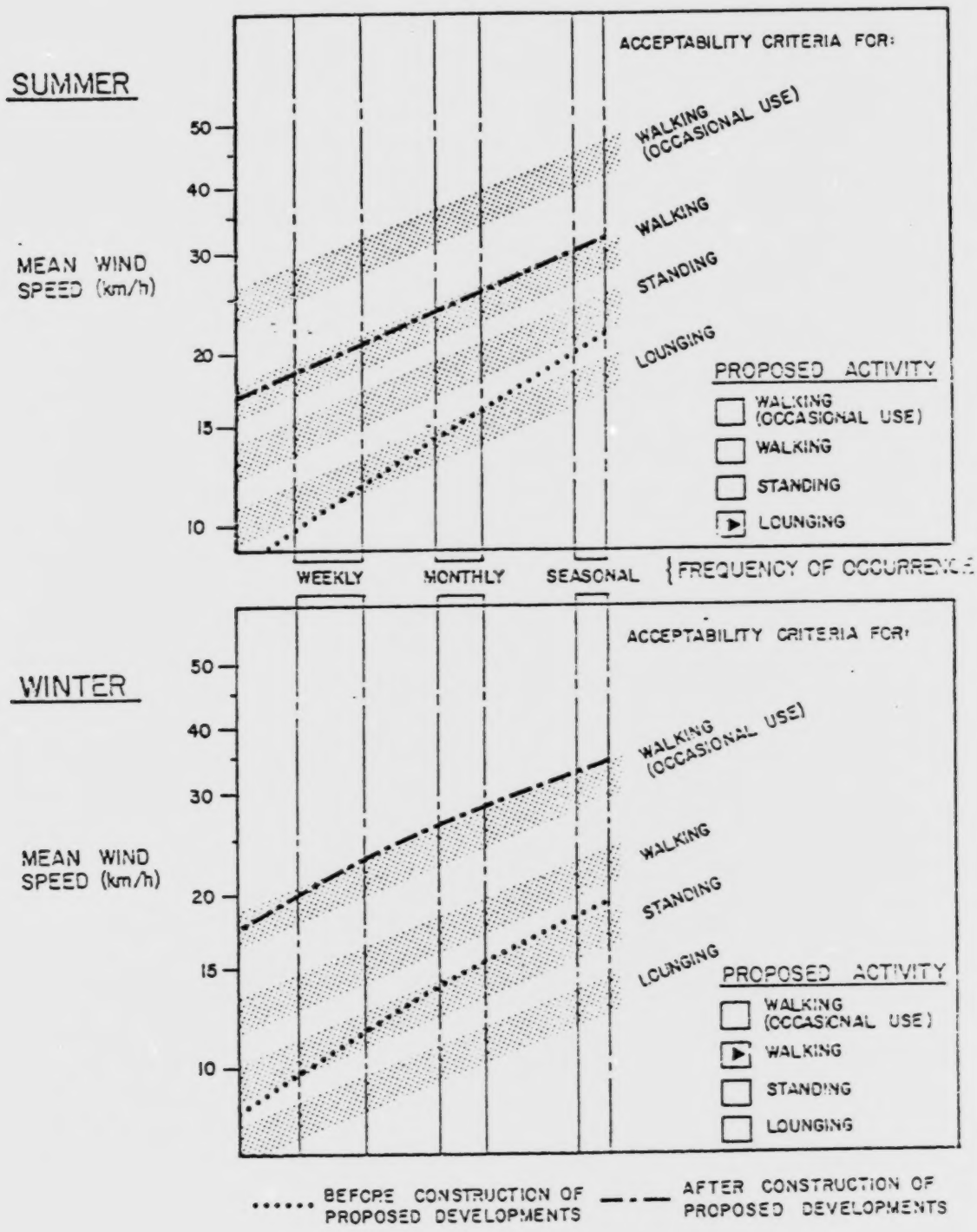
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (12)



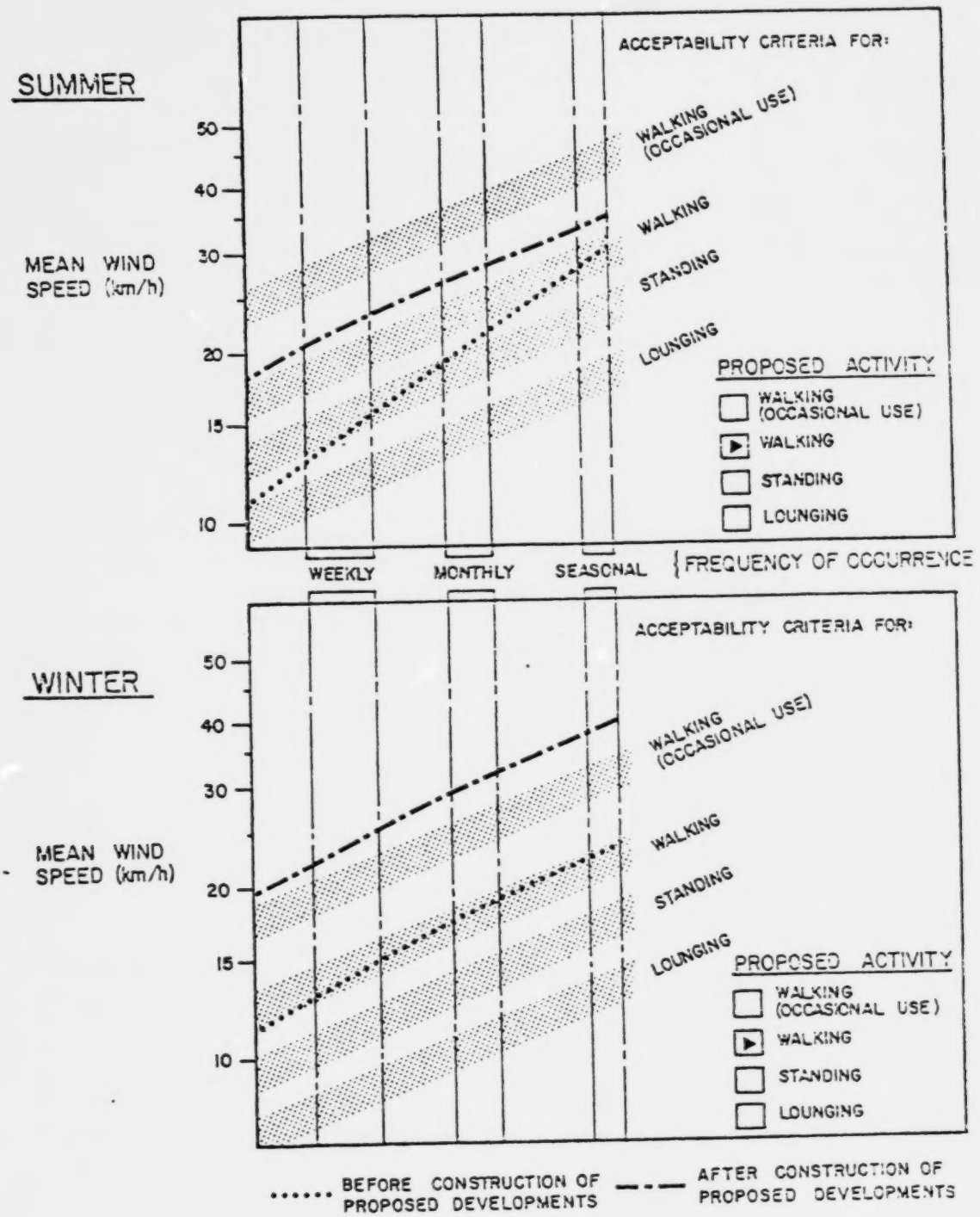
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (13)



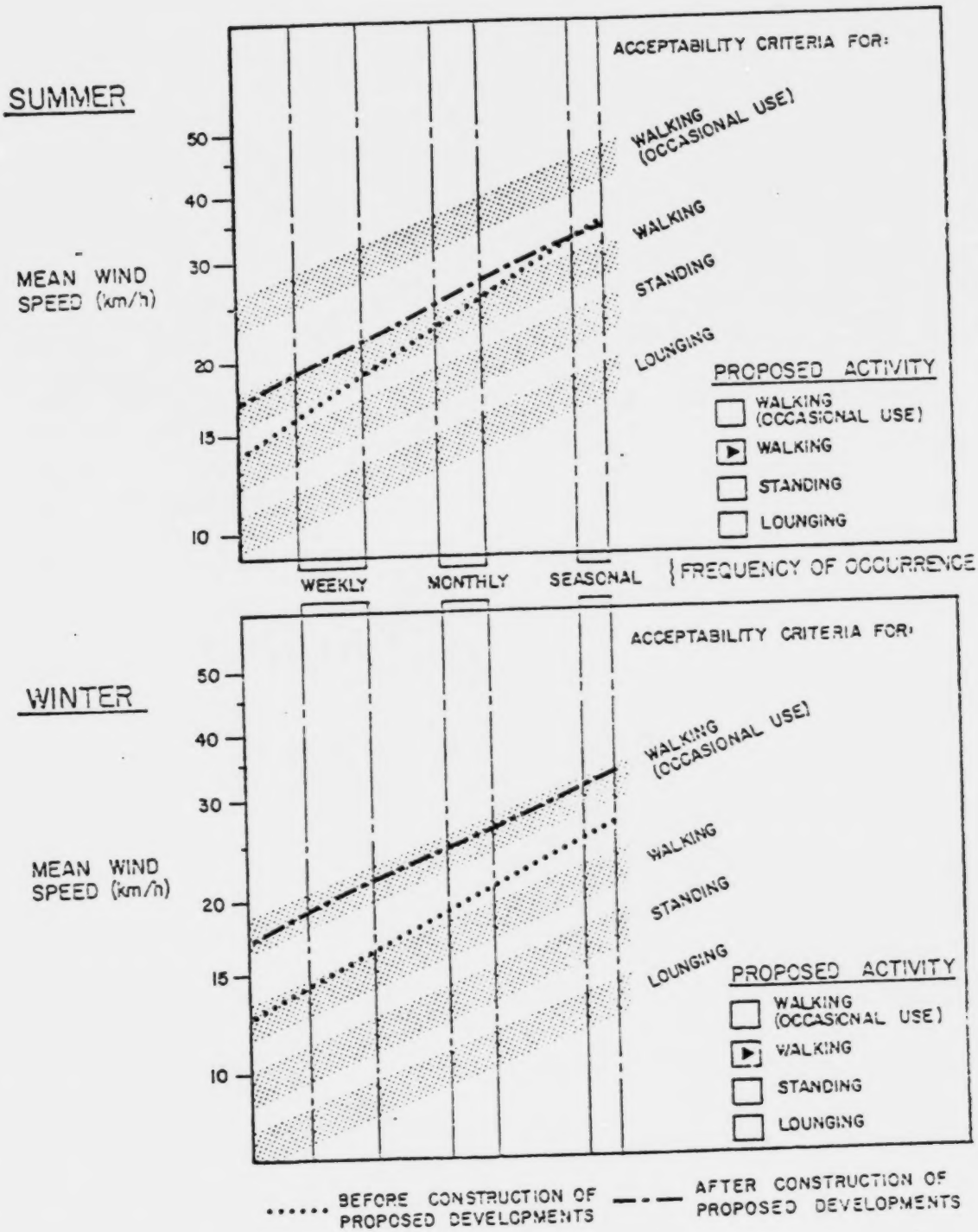
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (14)



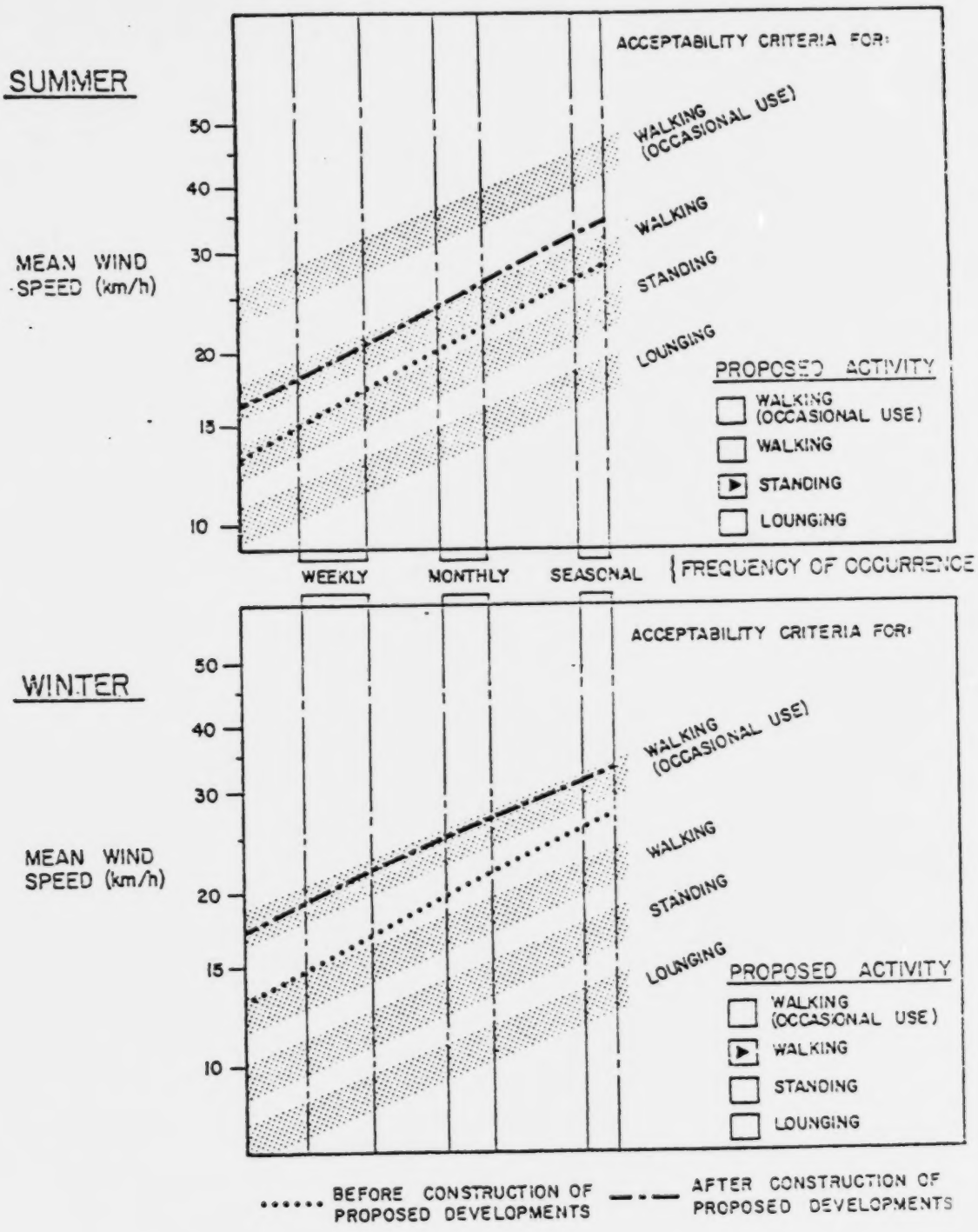
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (15)



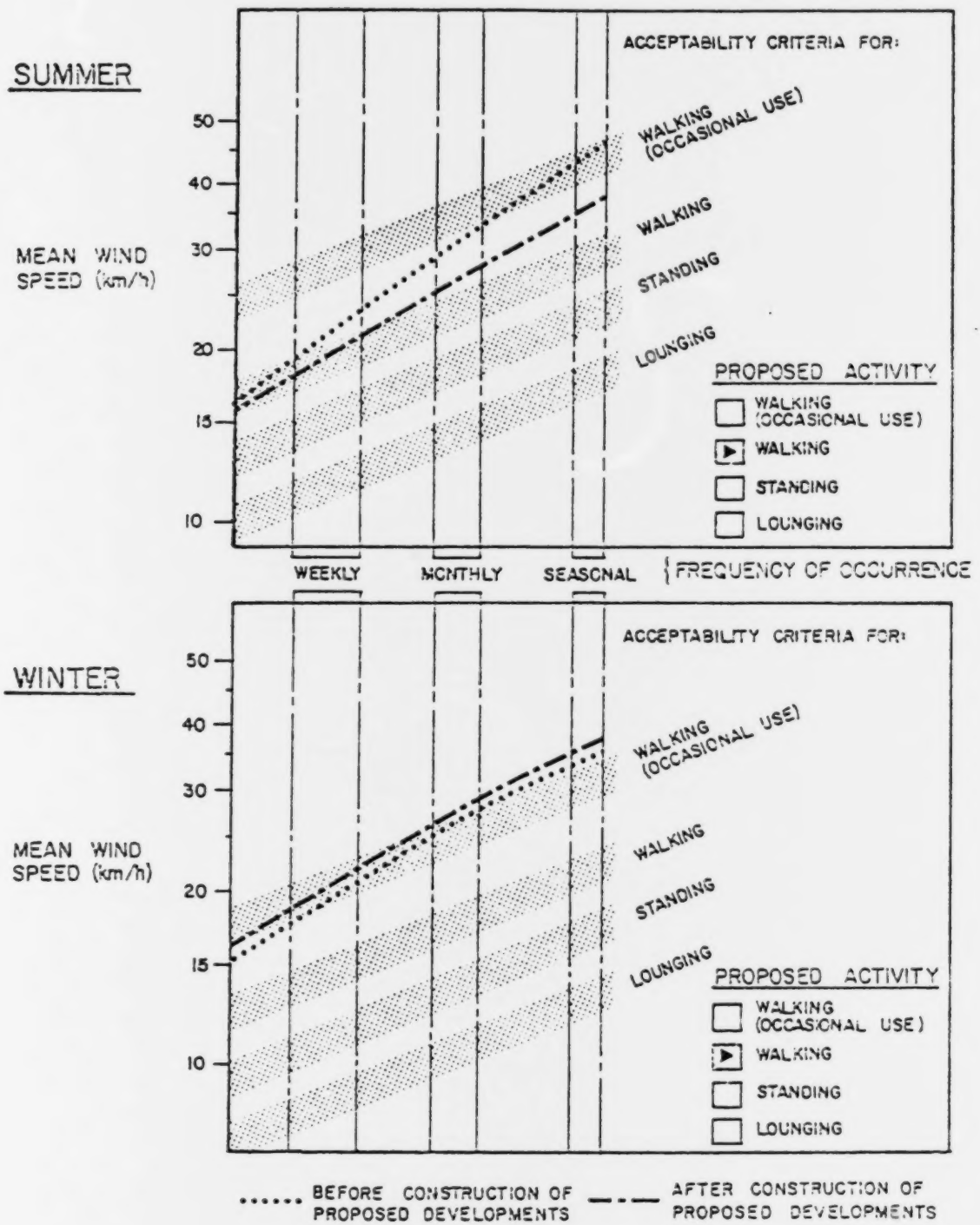
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (16)



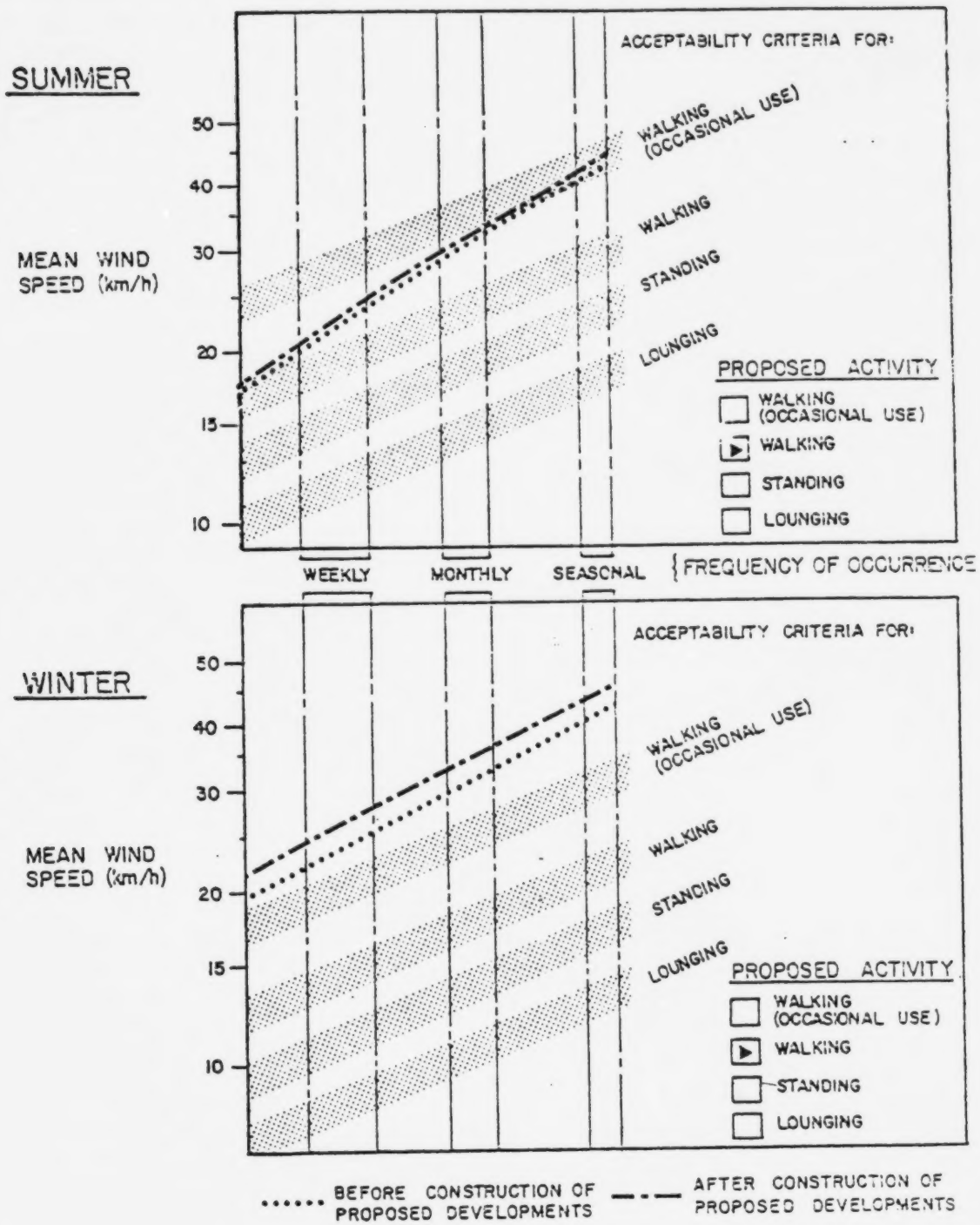
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (17)



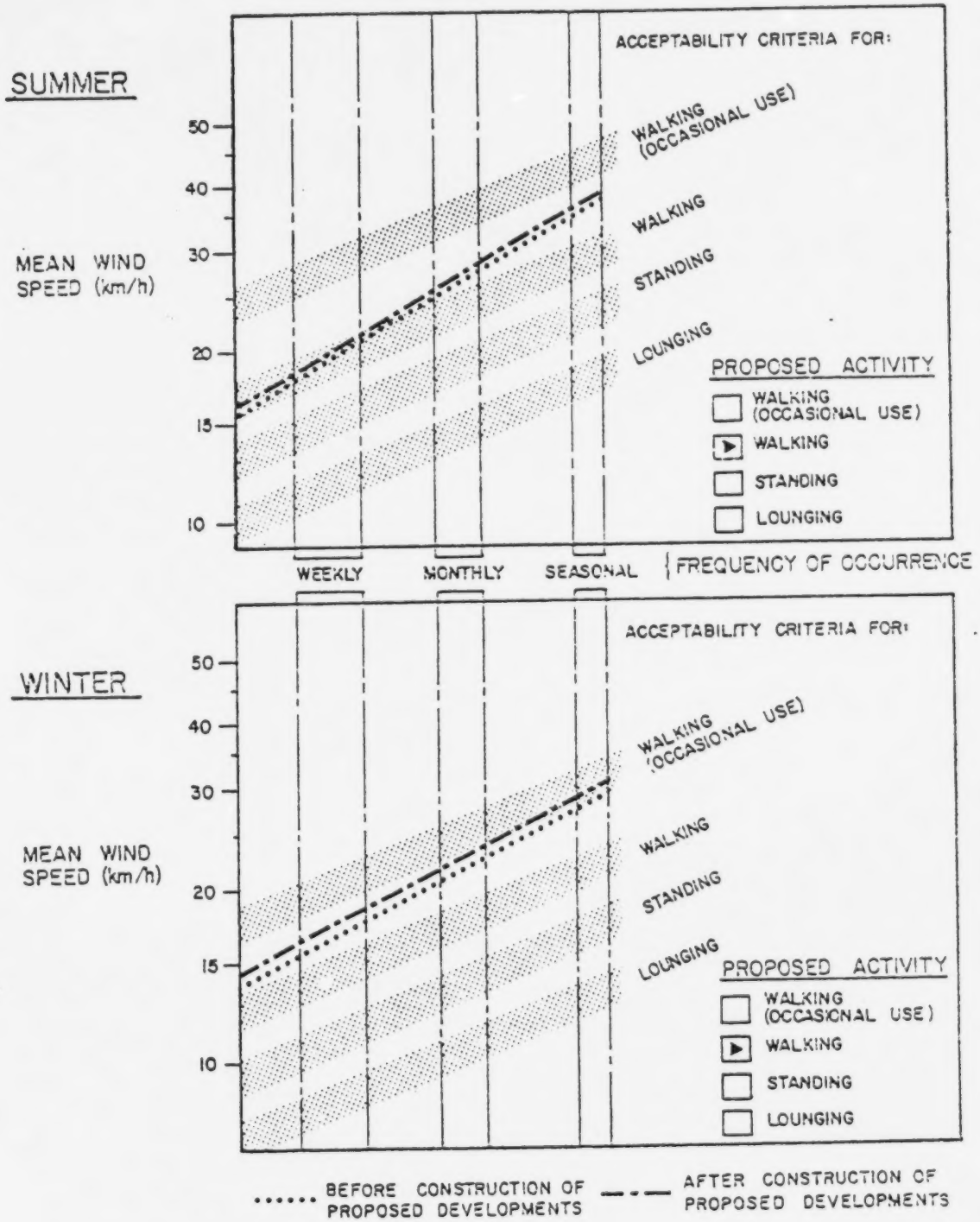
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (18)



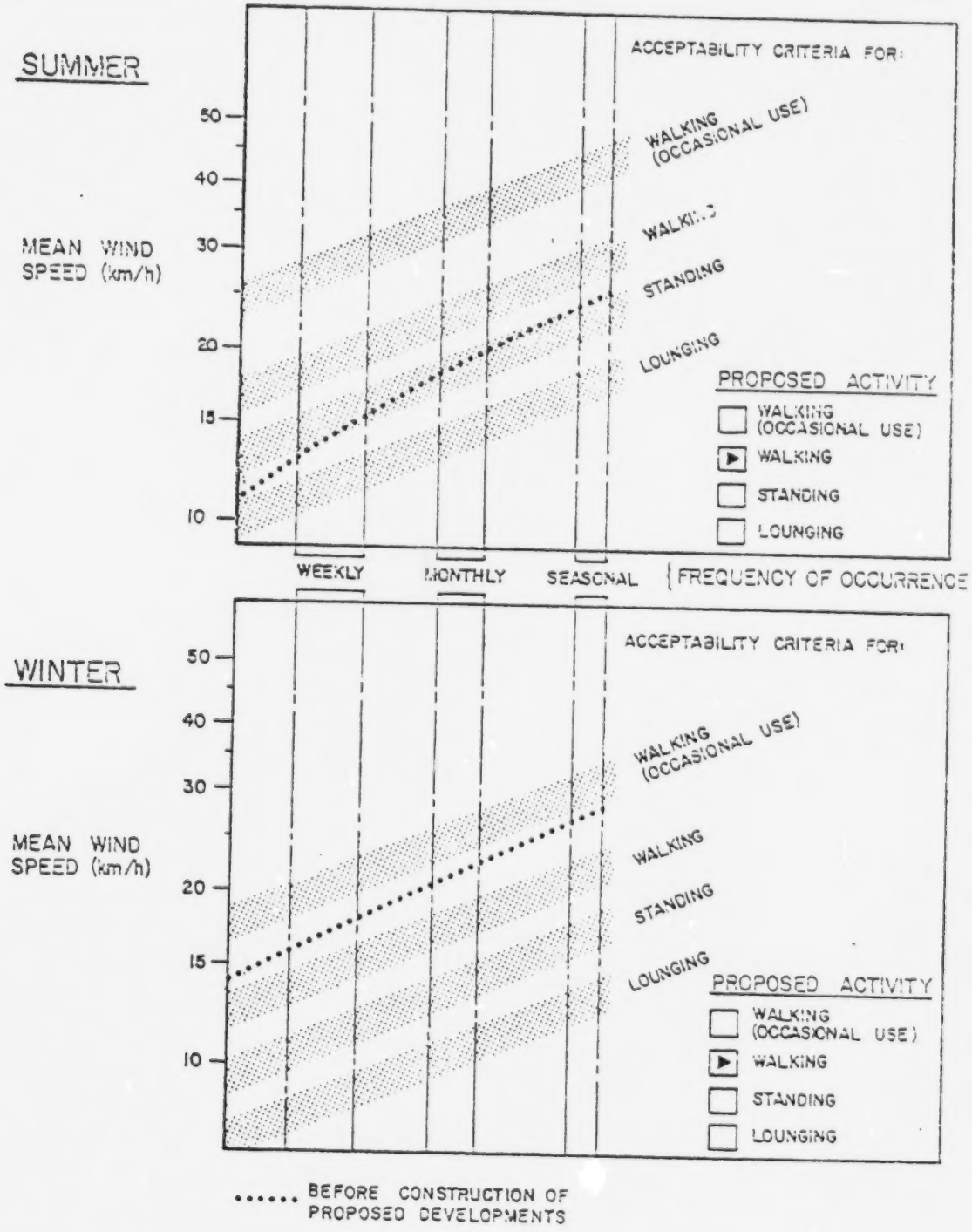
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (19)



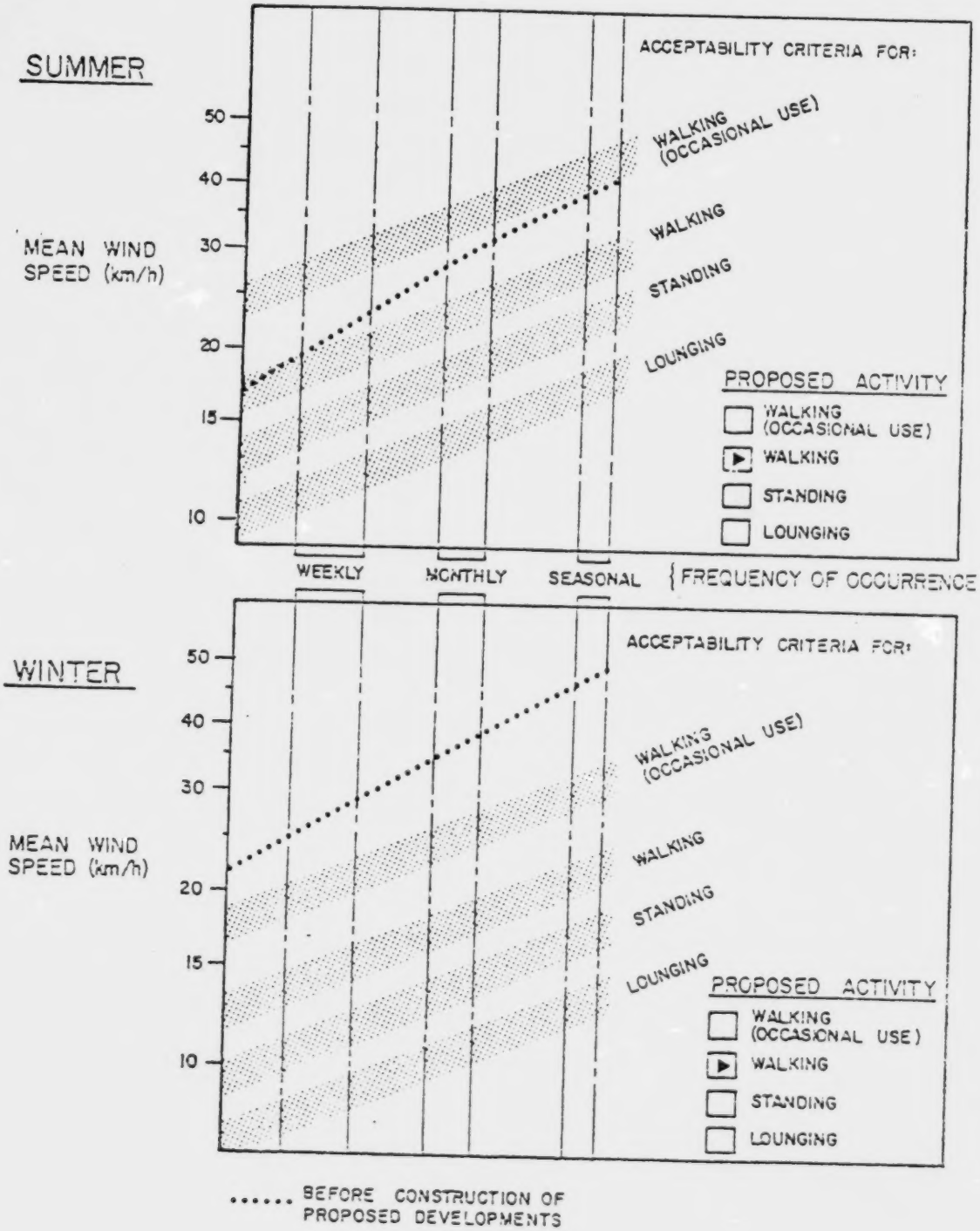
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (20)



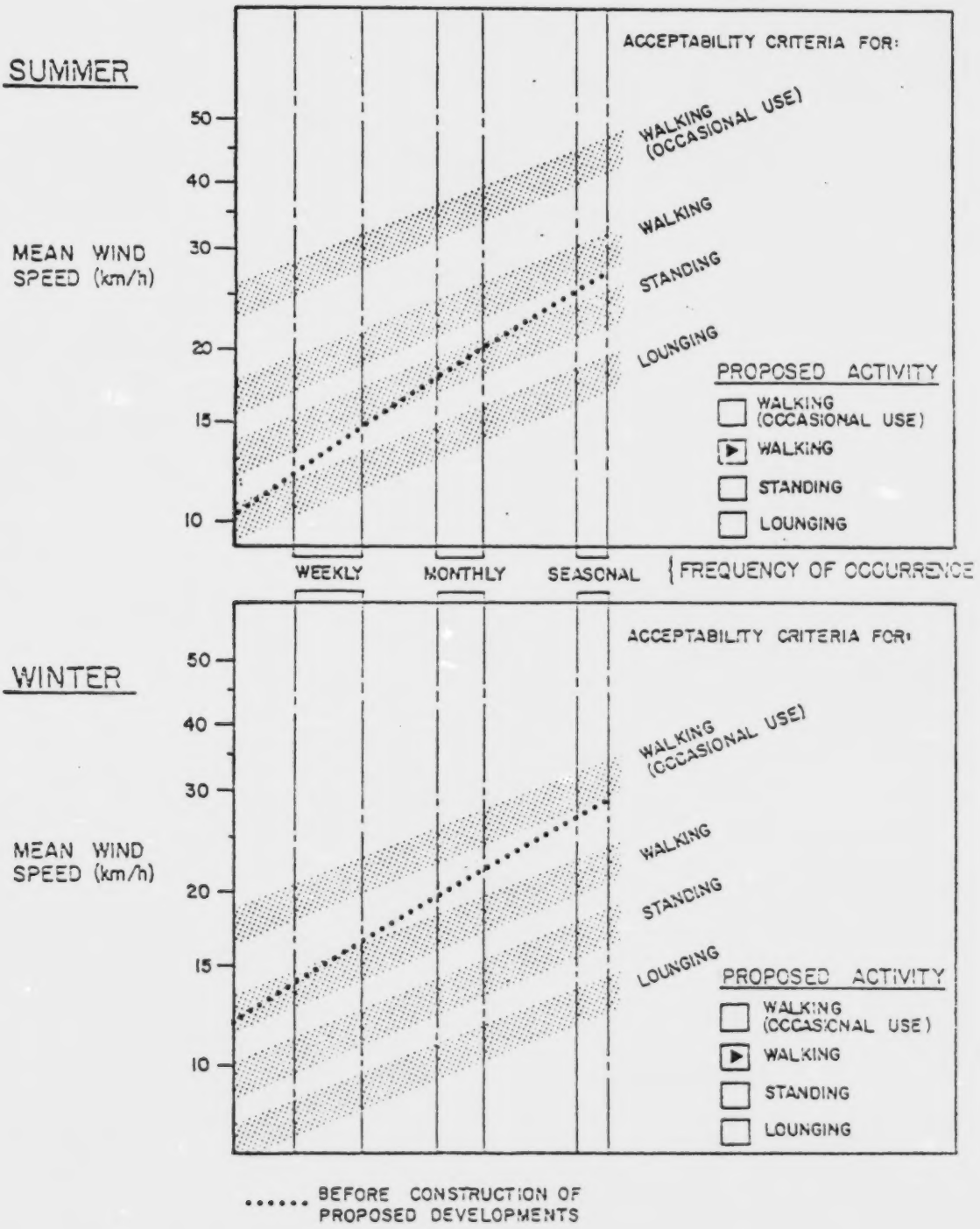
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (21)



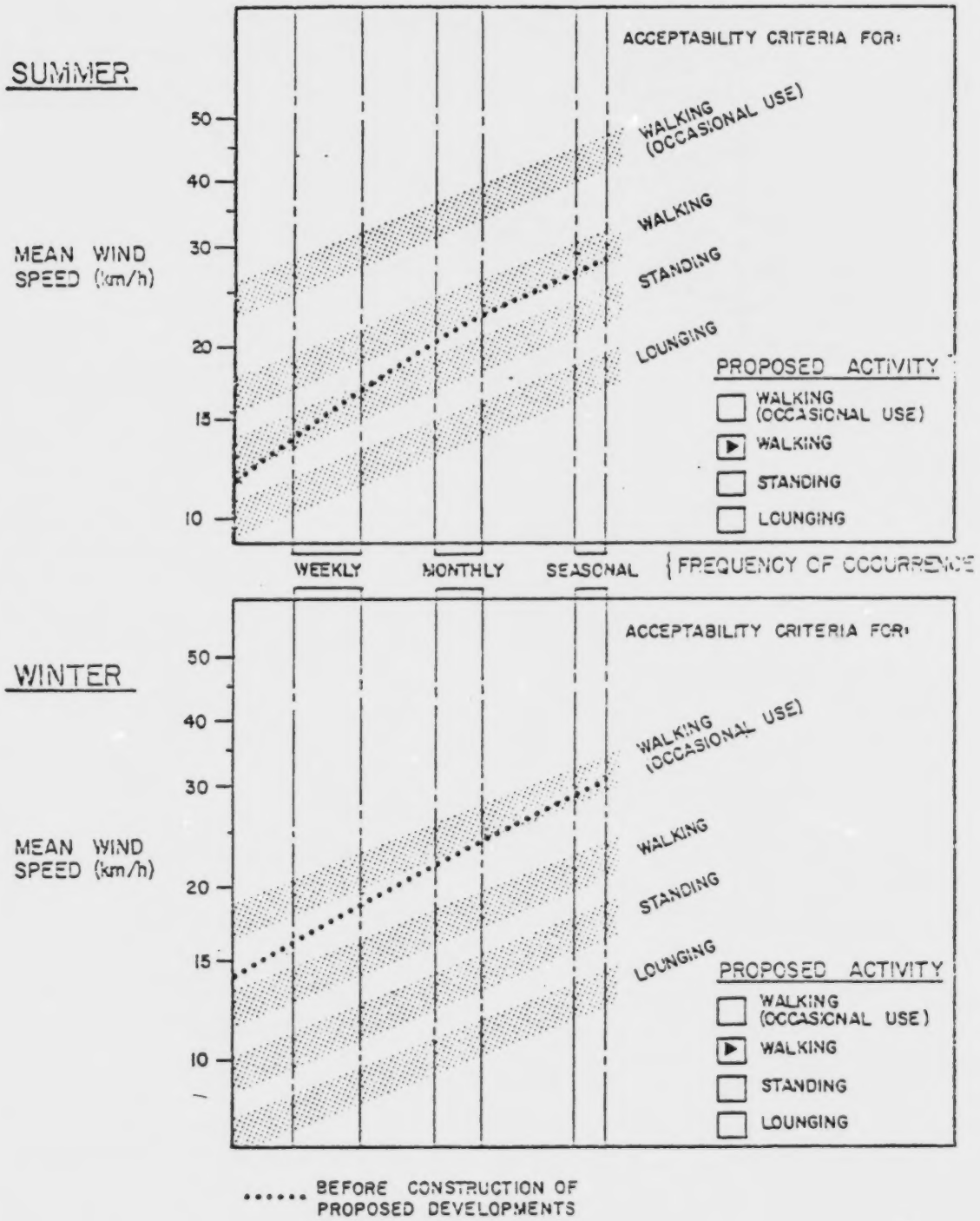
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (22)



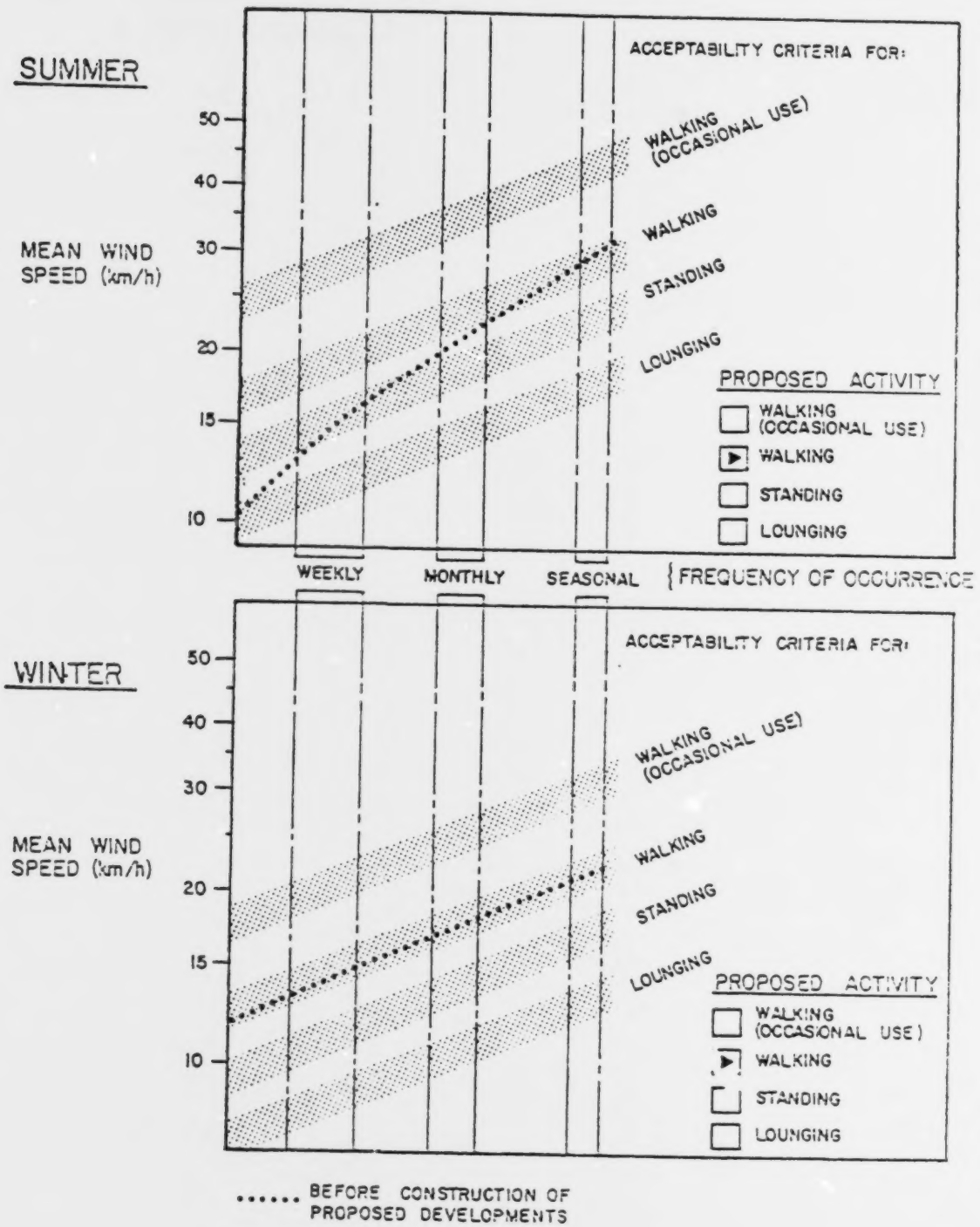
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (23)



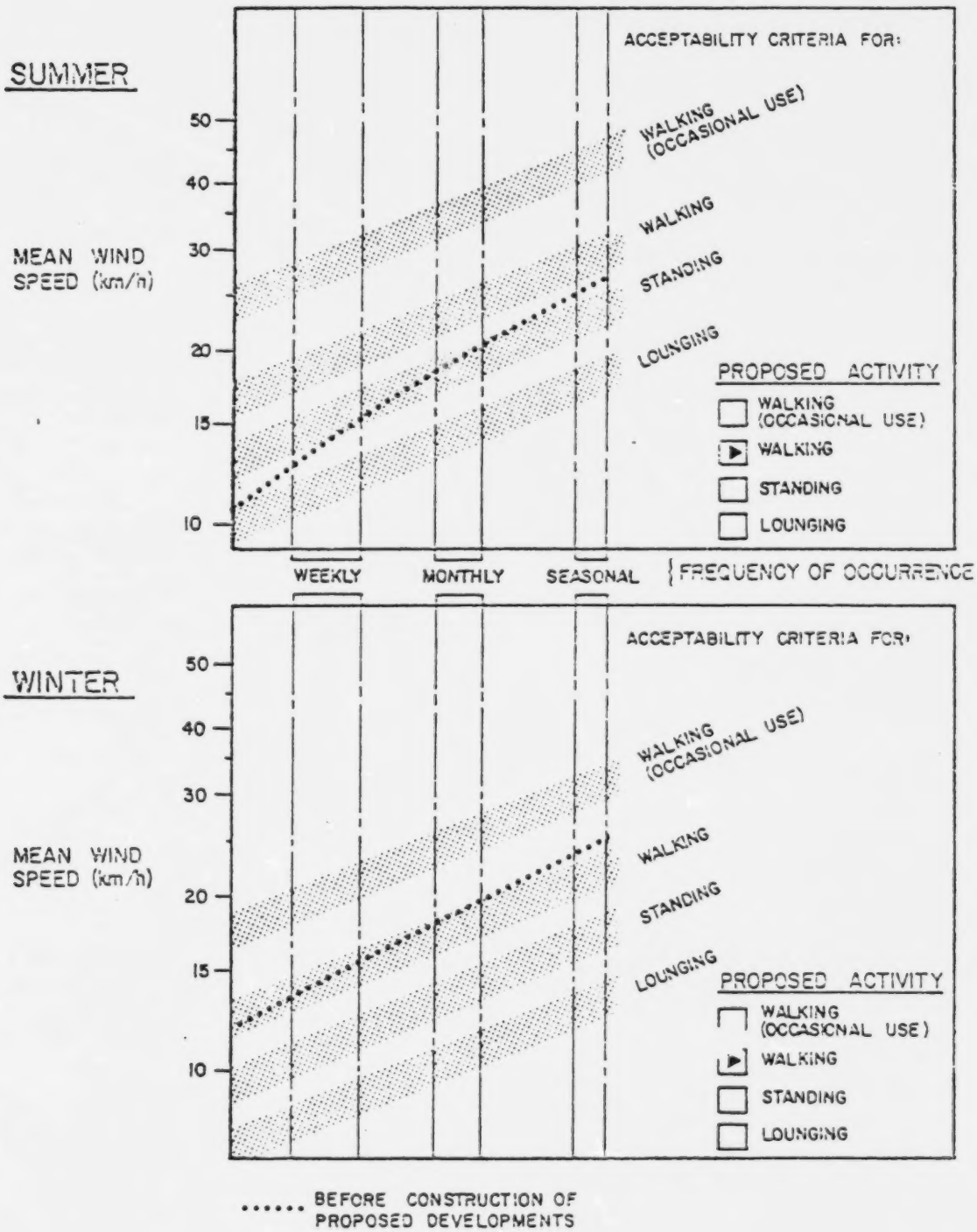
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (24)



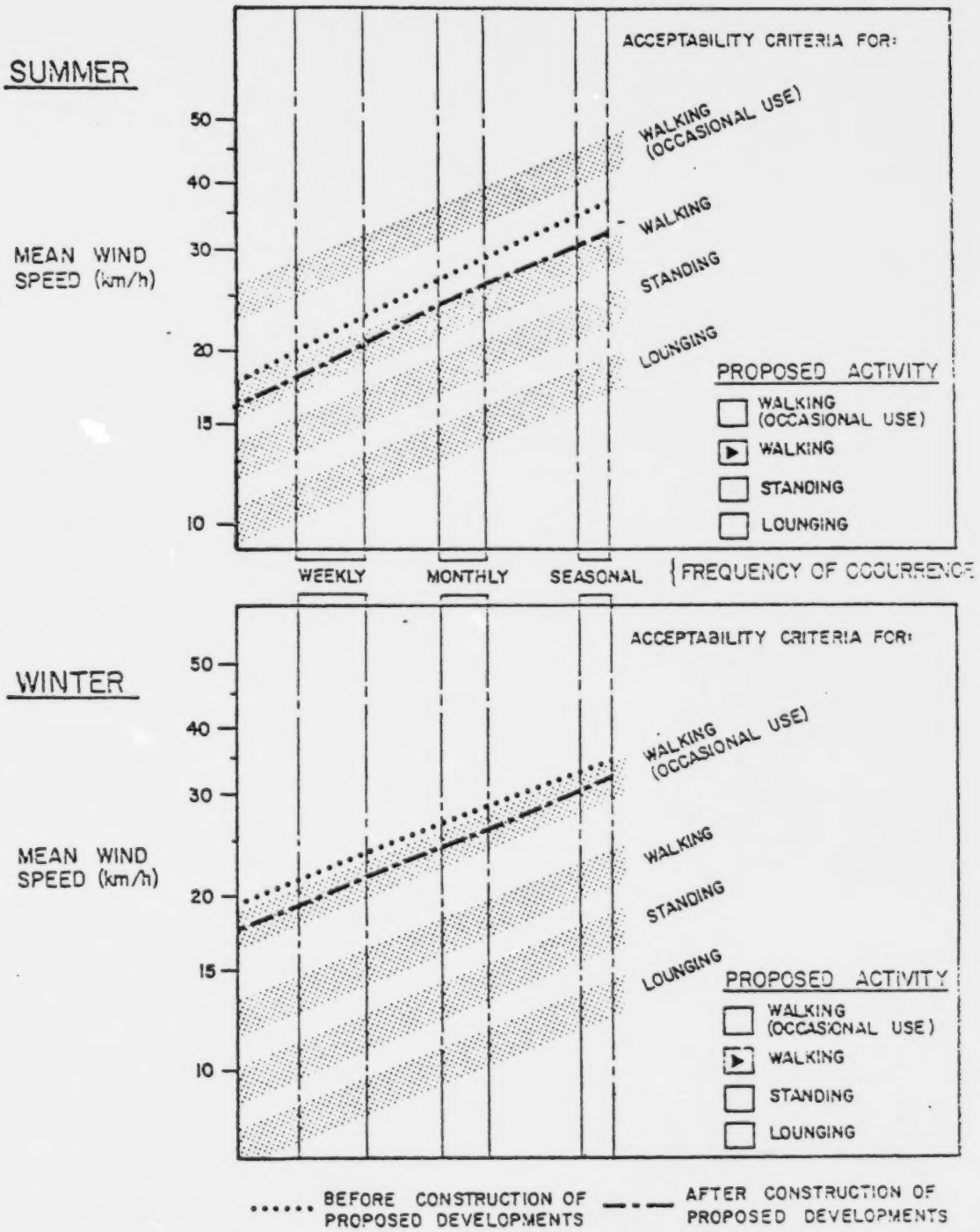
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (25)



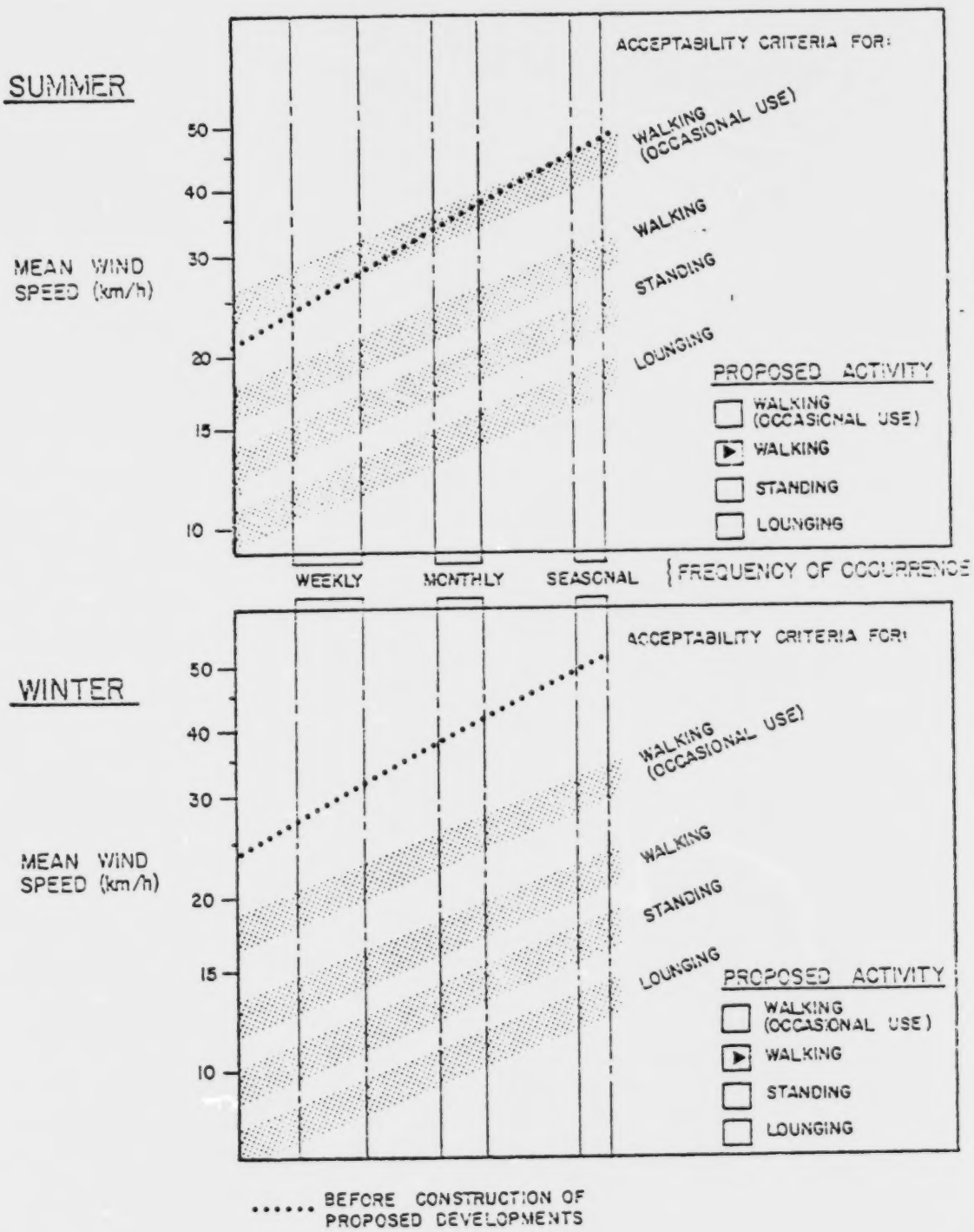
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (26)



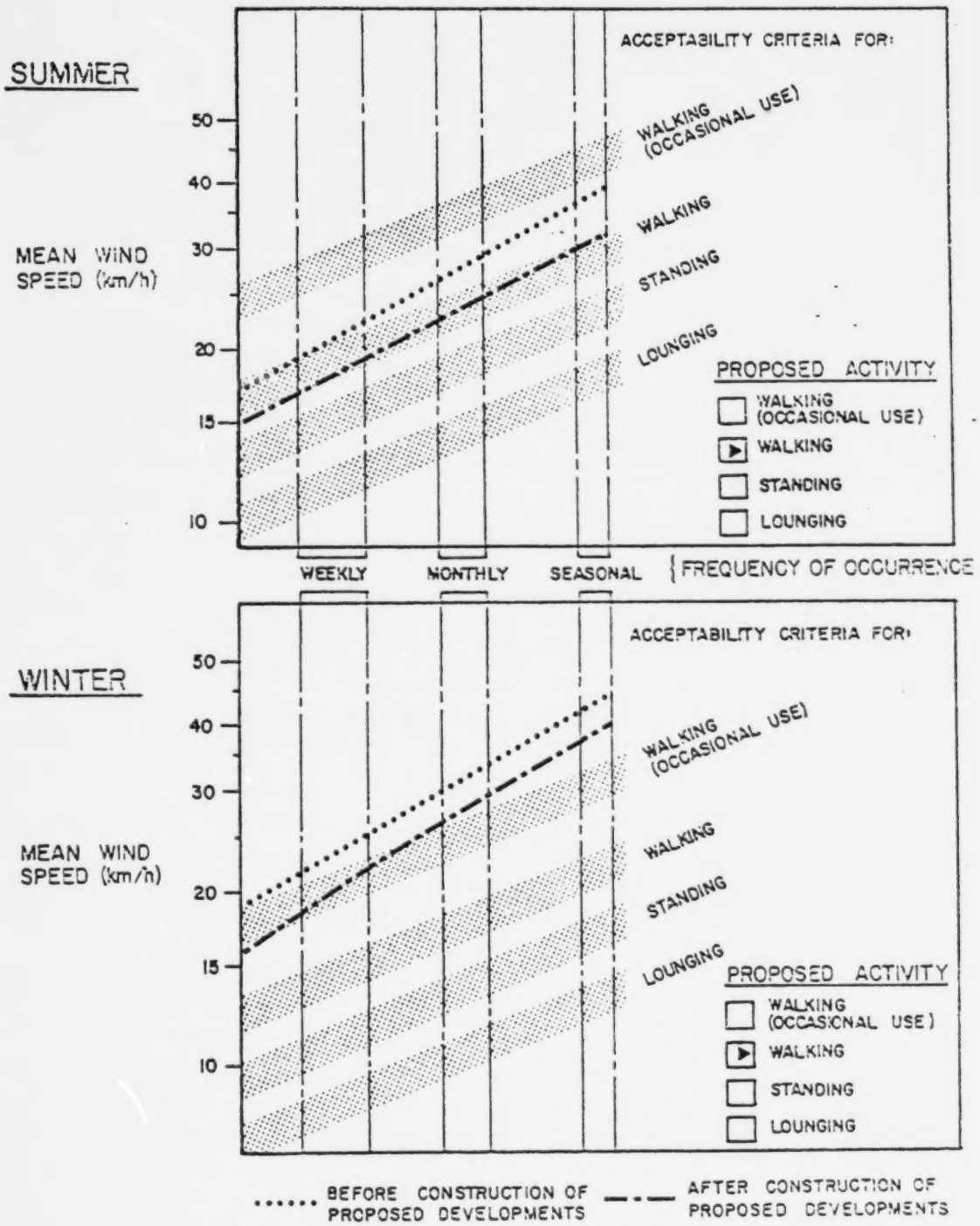
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (27)



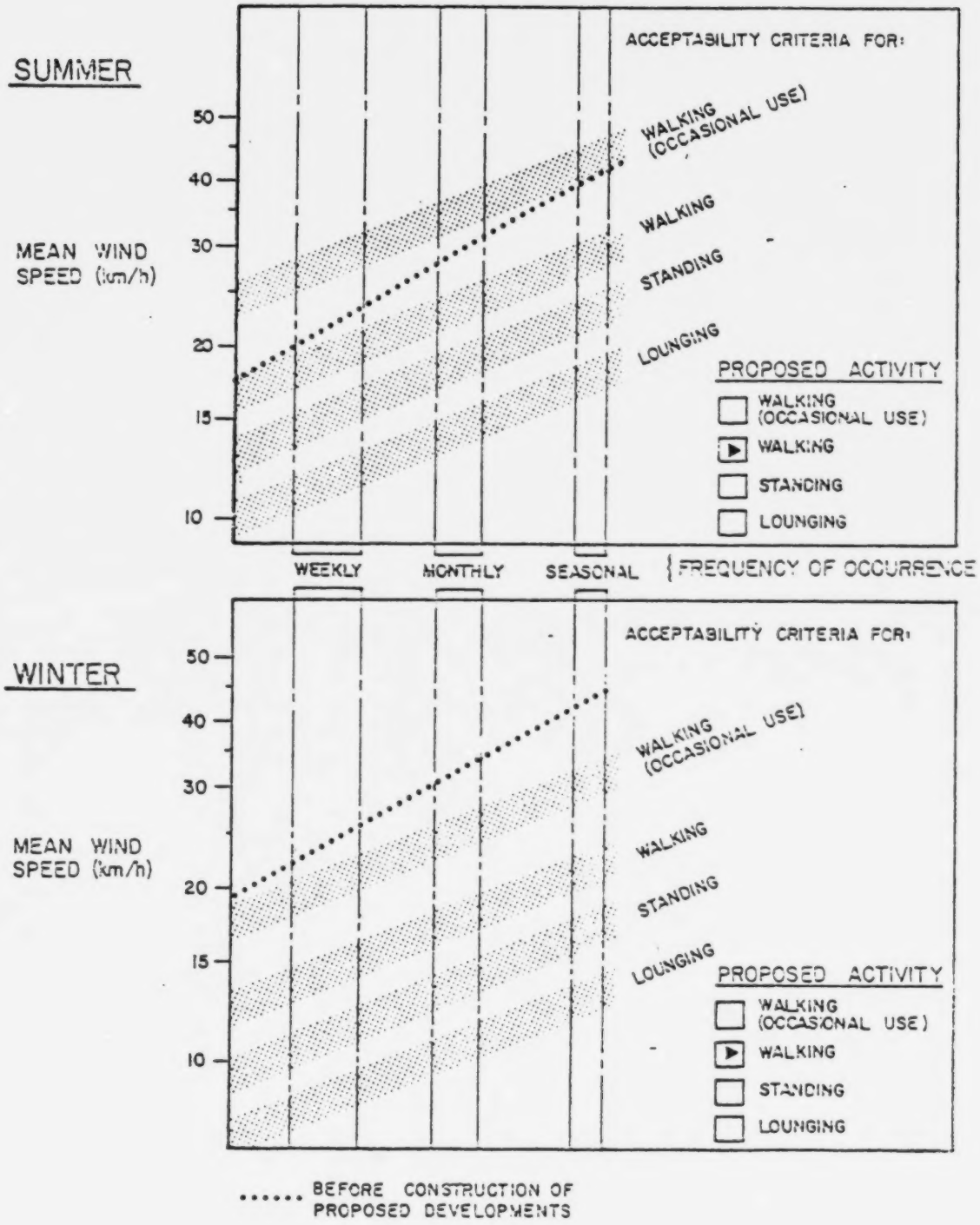
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (28)



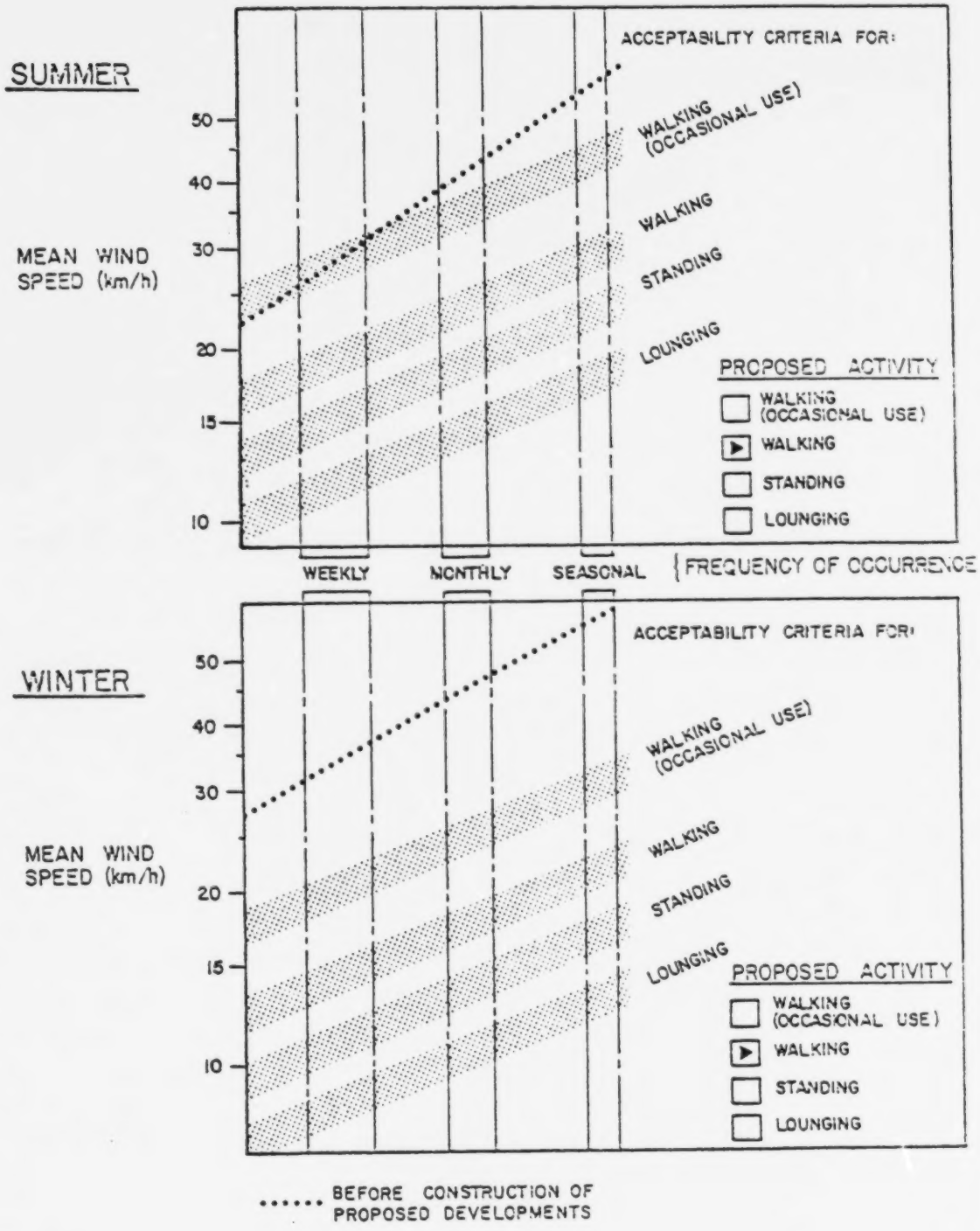
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (29)



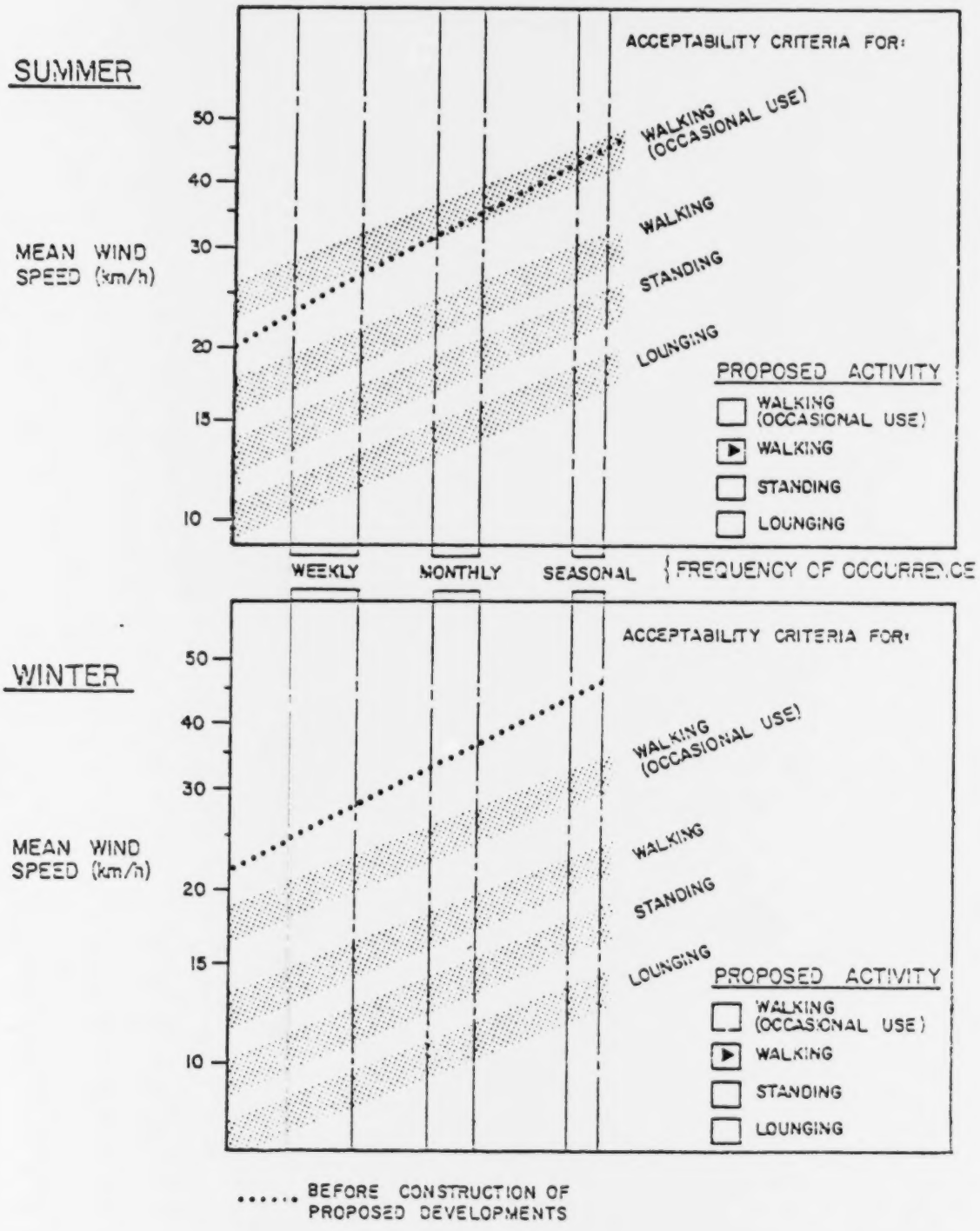
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (30)



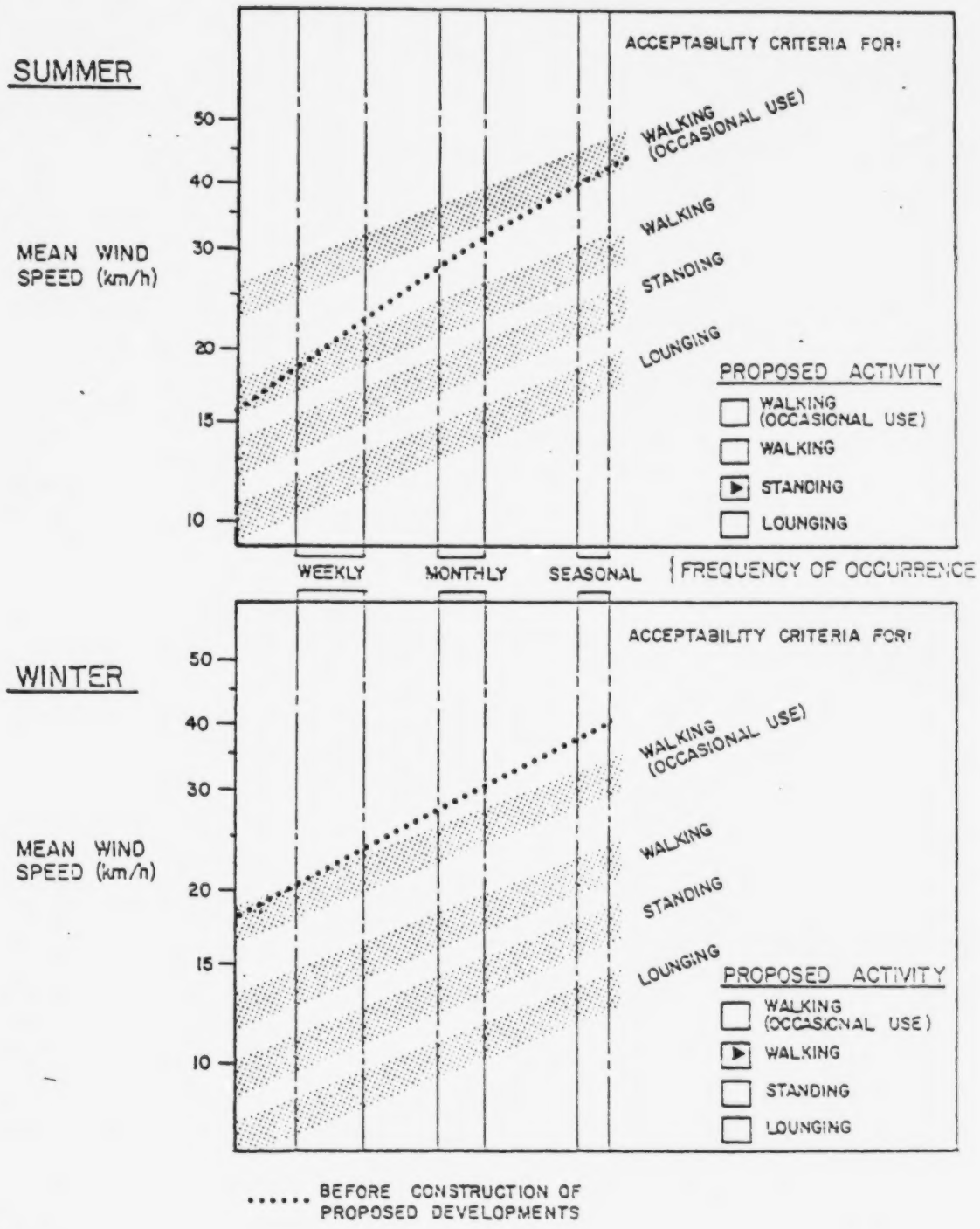
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (31)



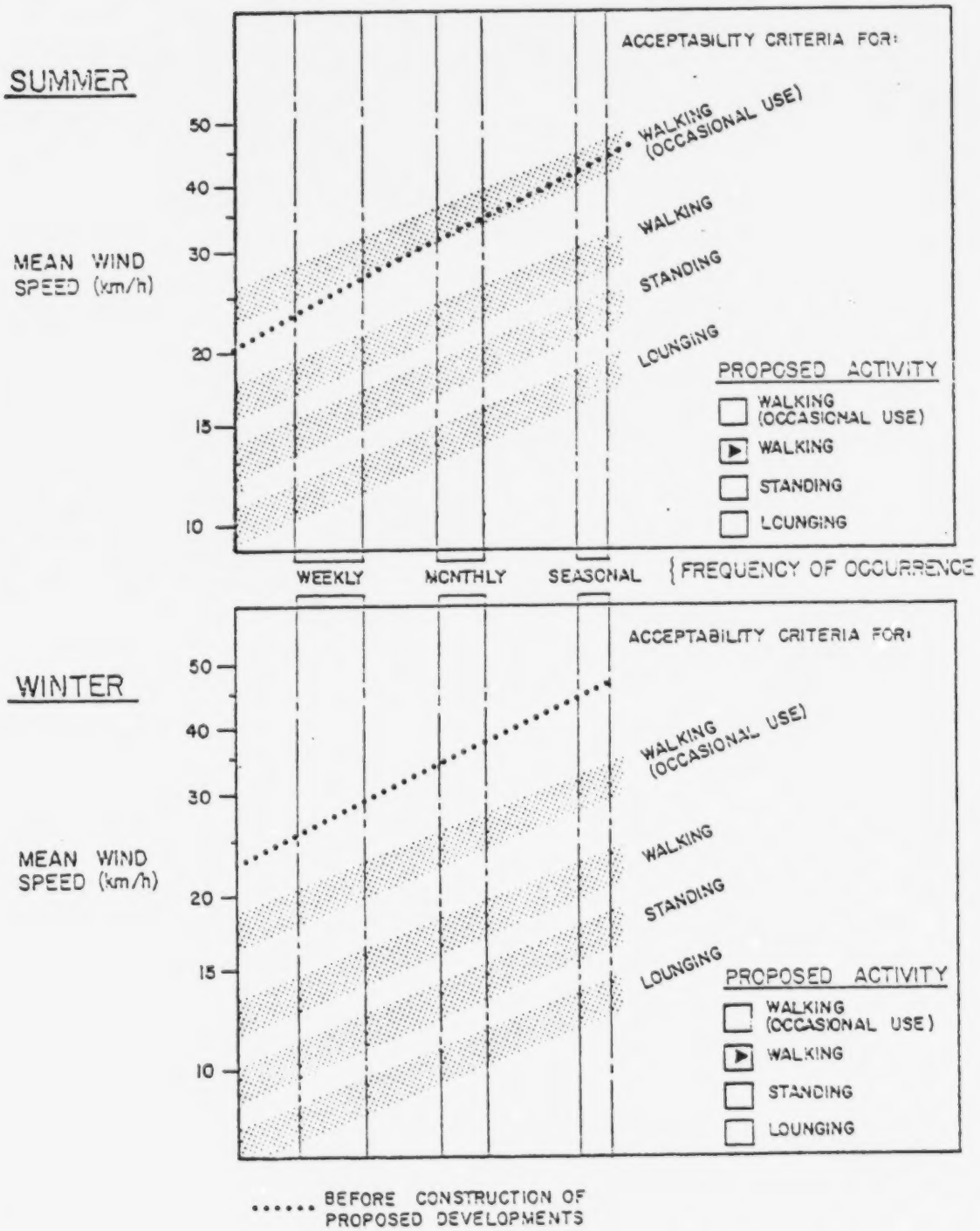
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (32)



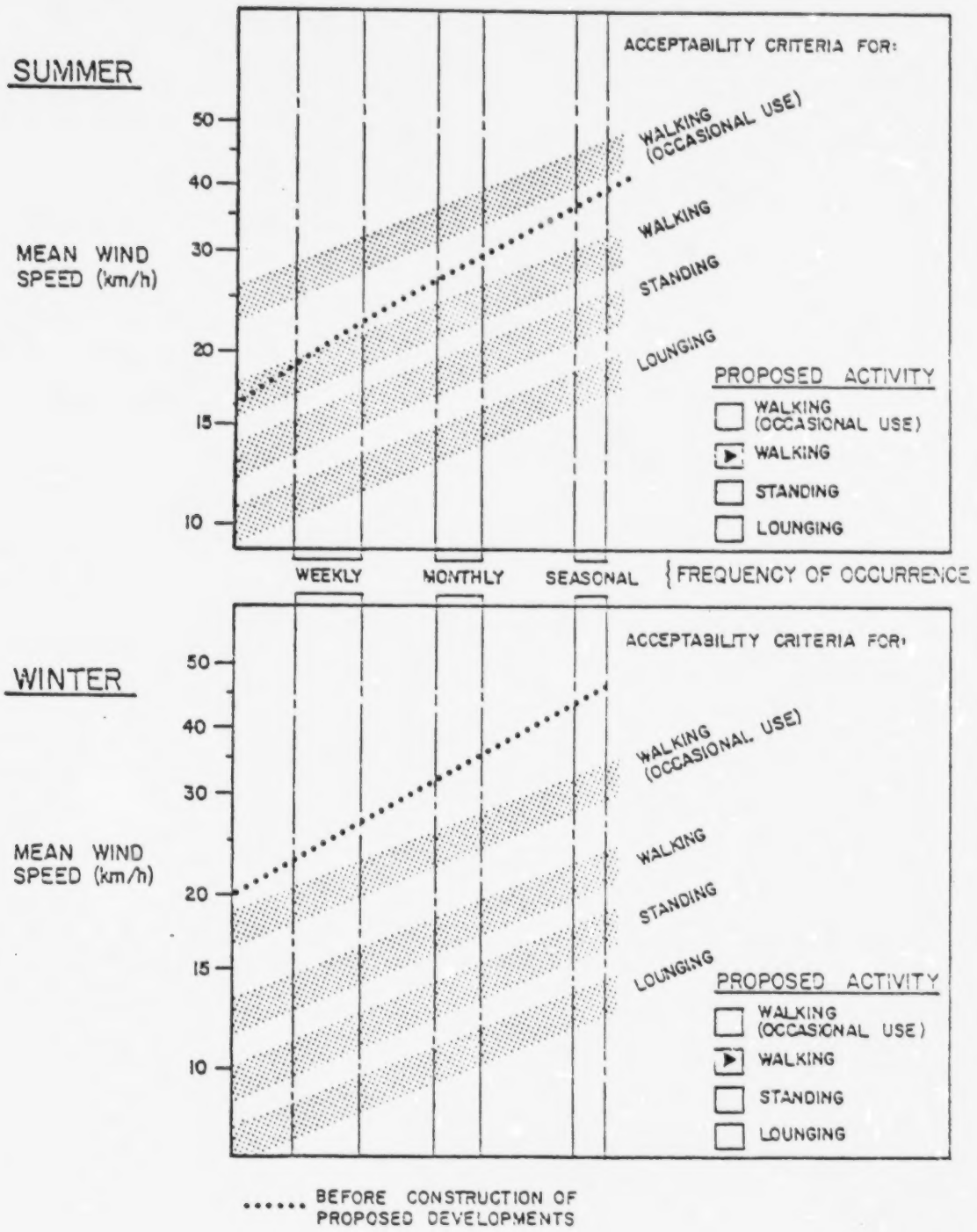
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (33)



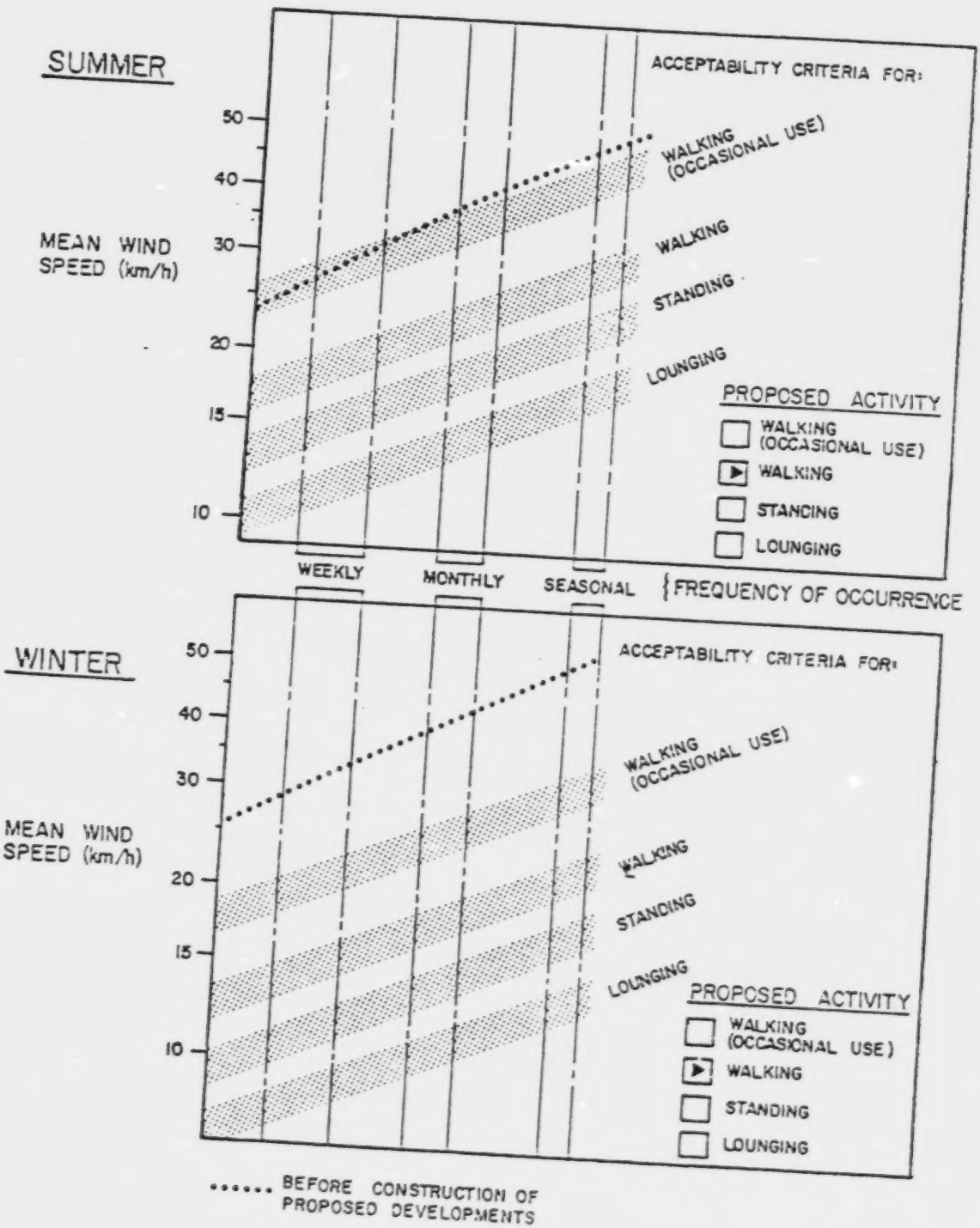
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (34)



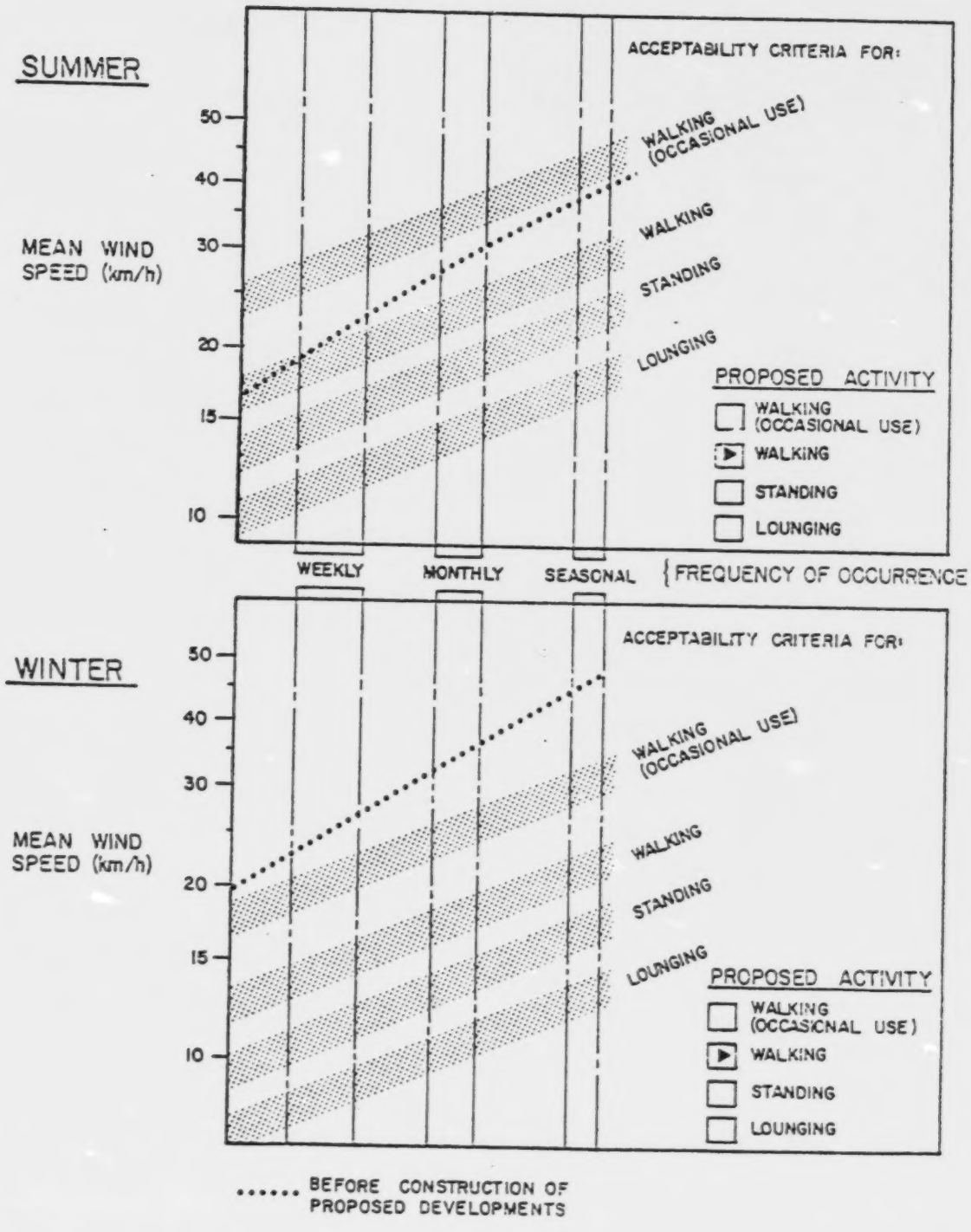
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (35)



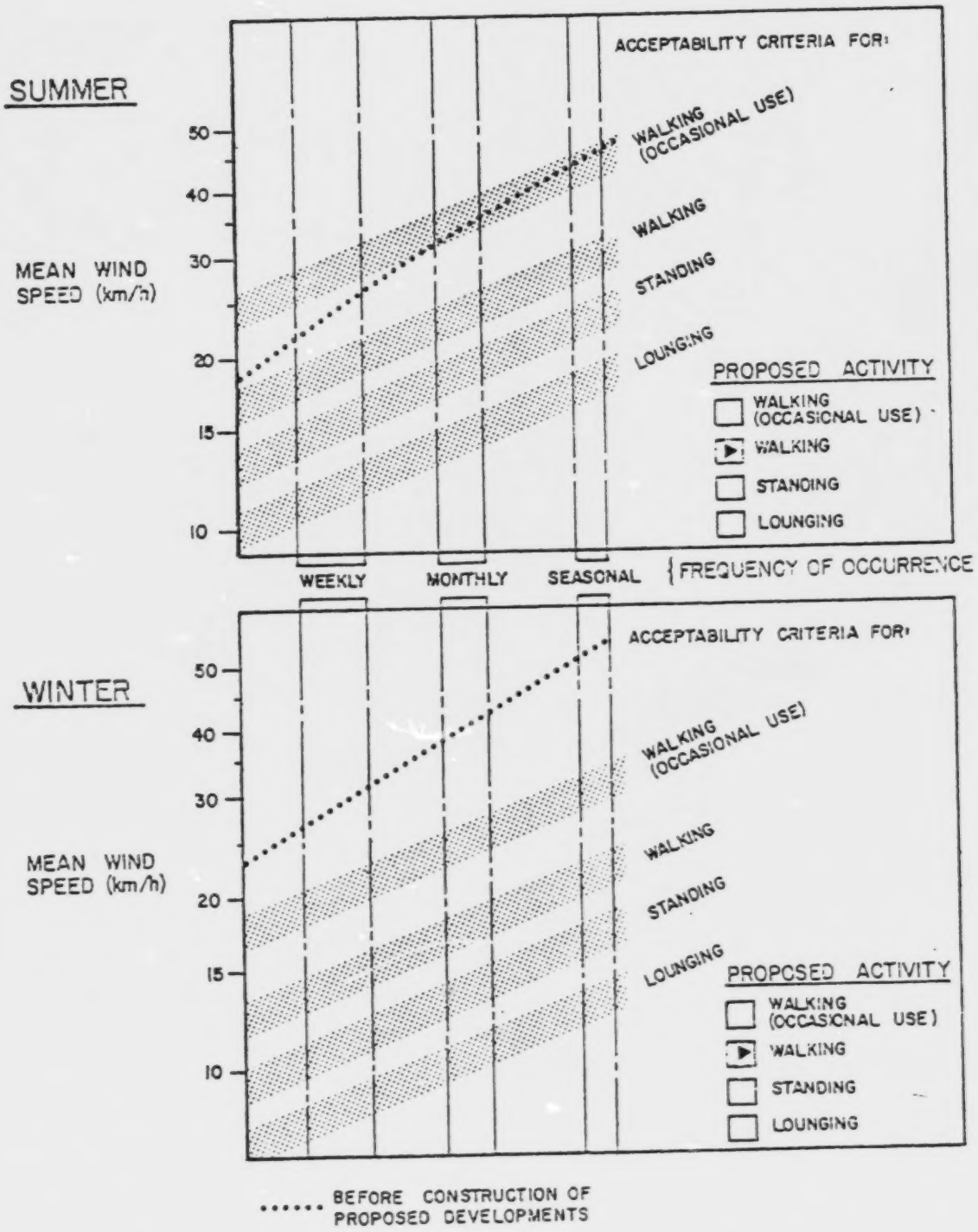
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (36)



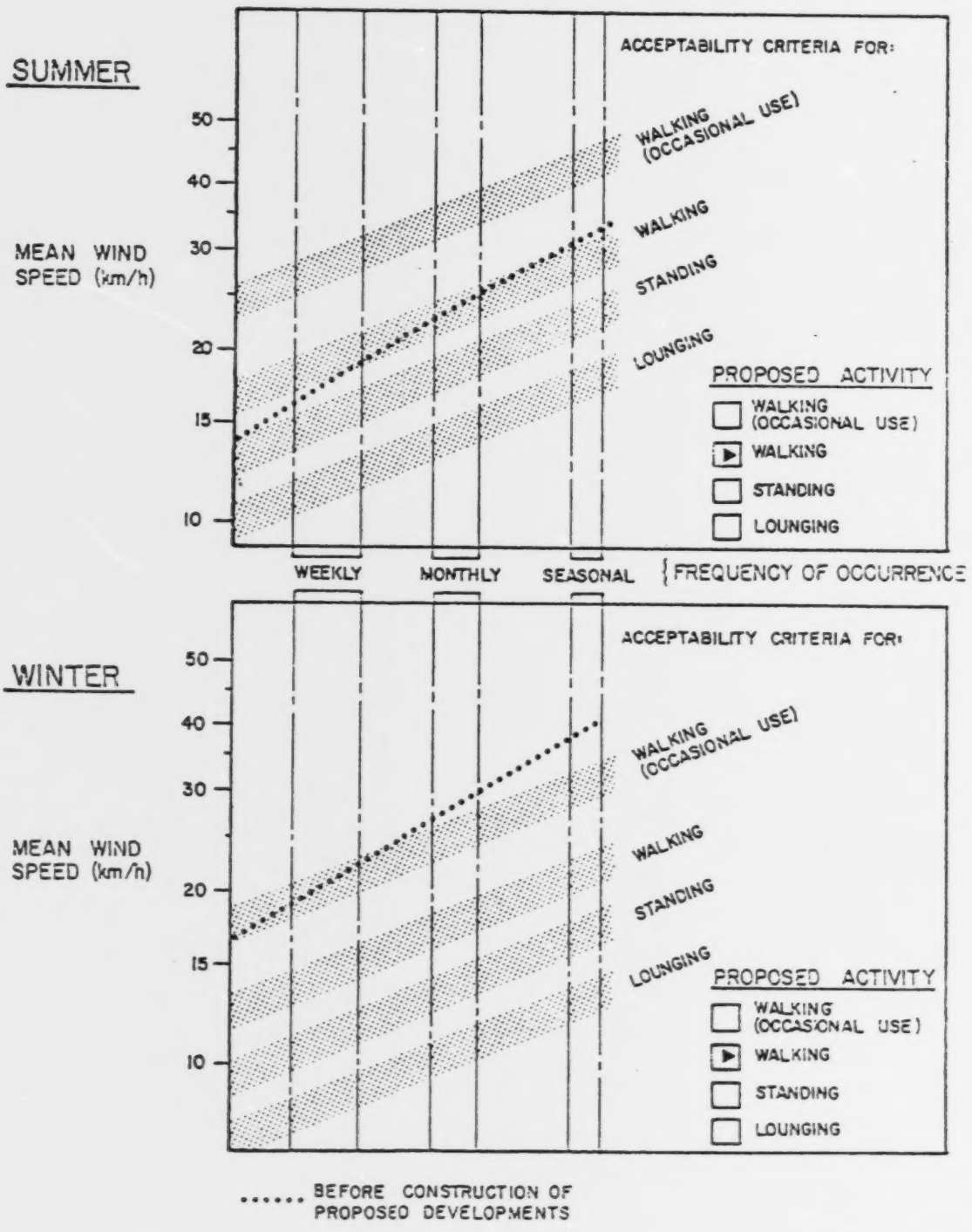
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (37)



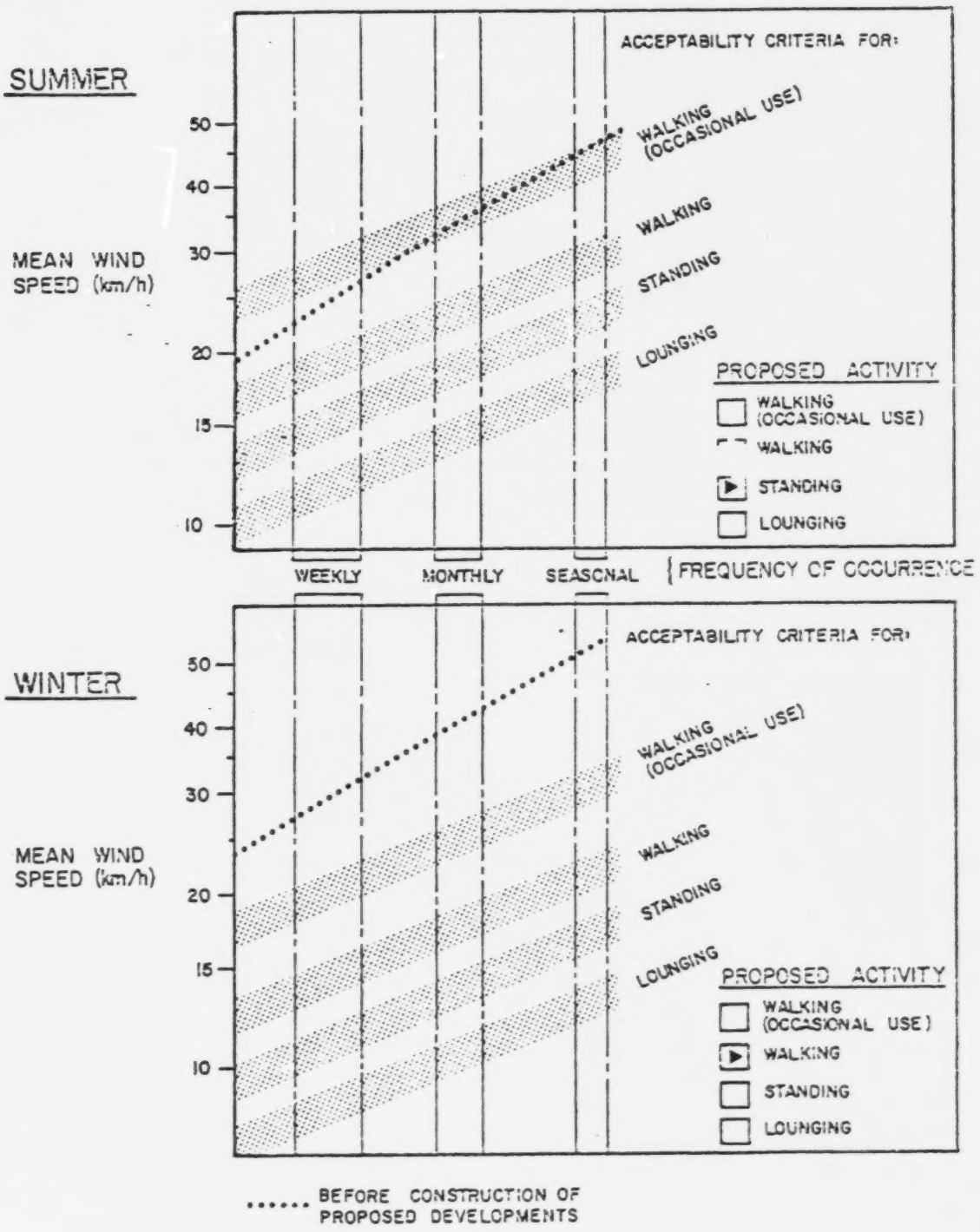
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (38)



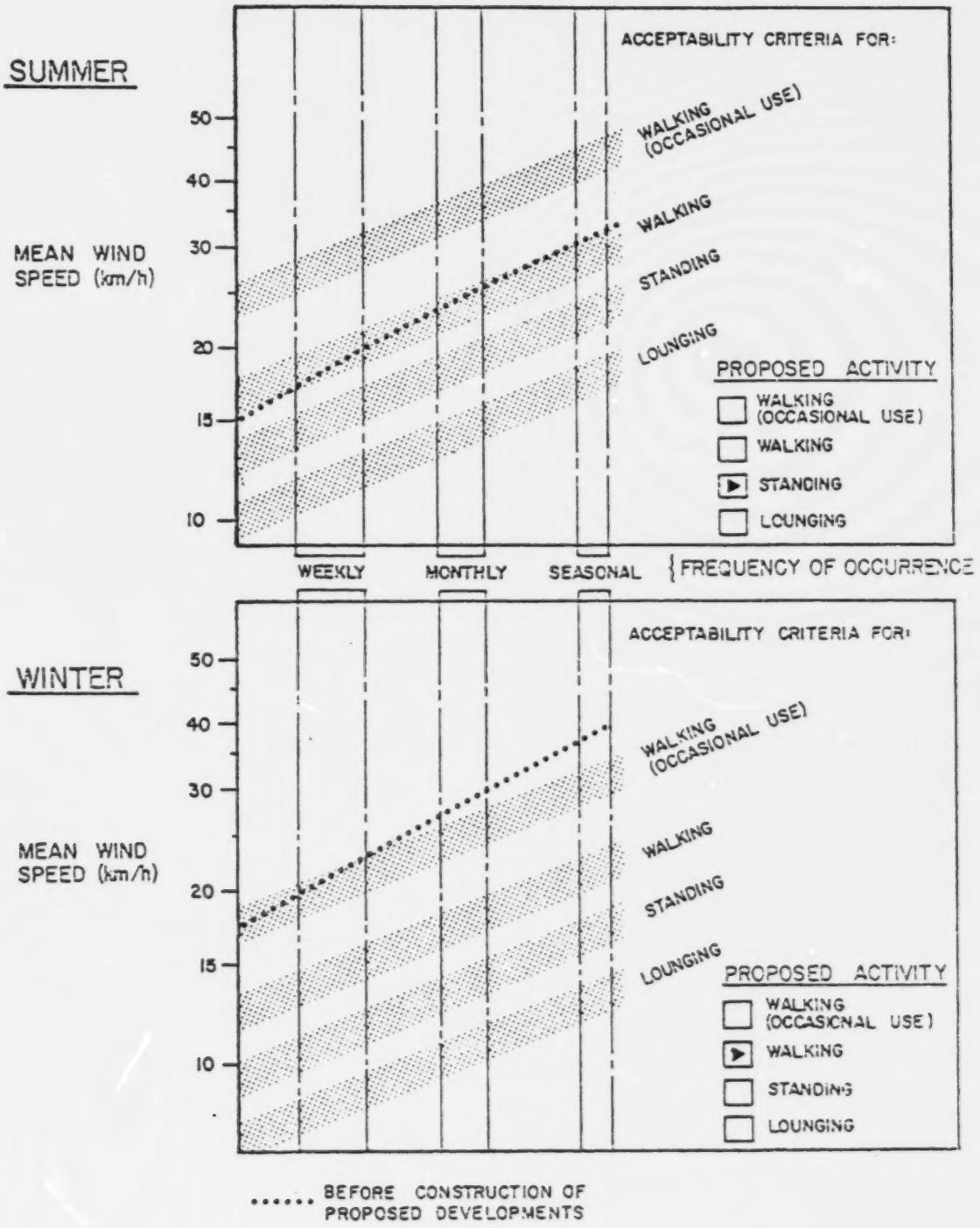
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (39)



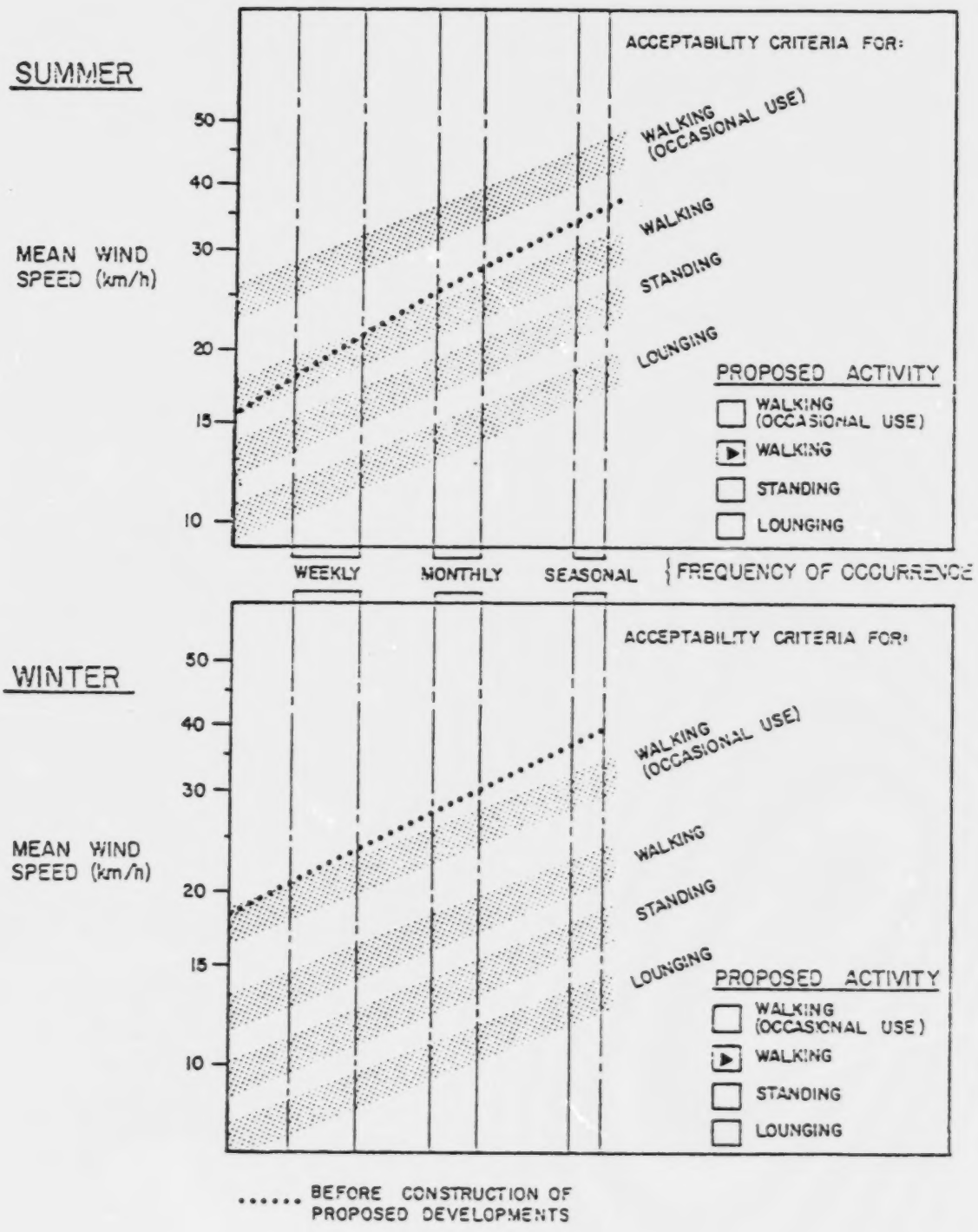
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (40)



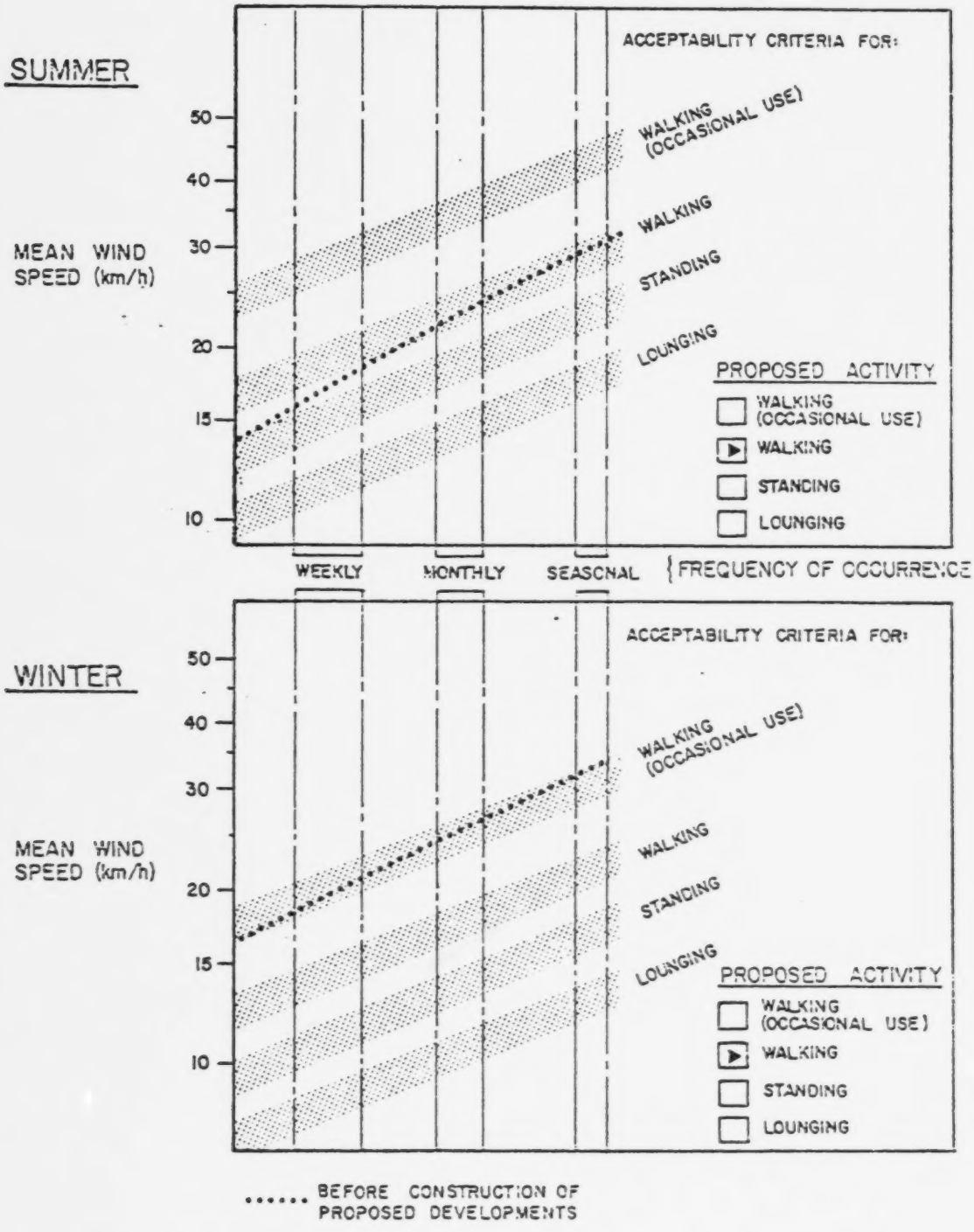
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (41)



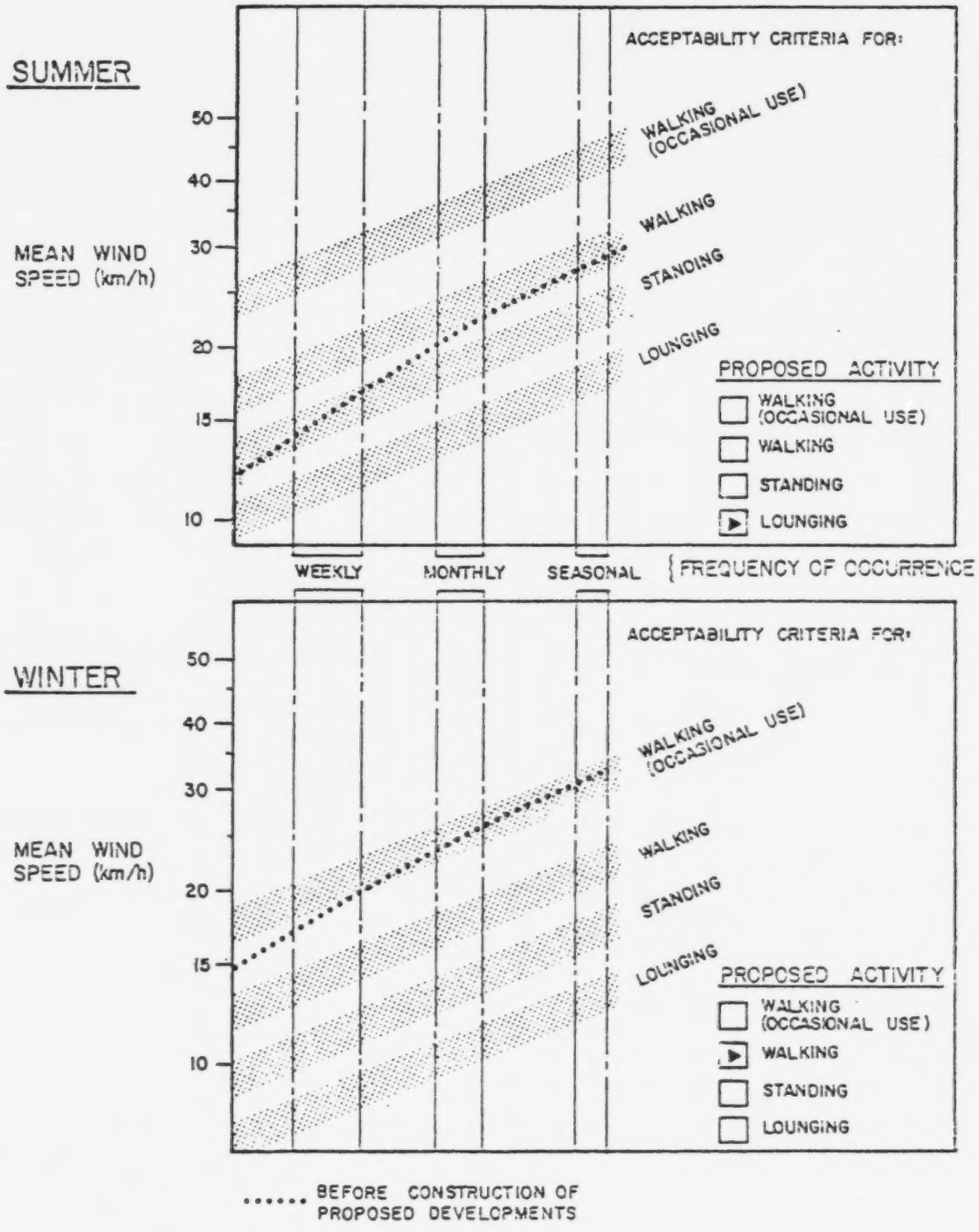
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (42)



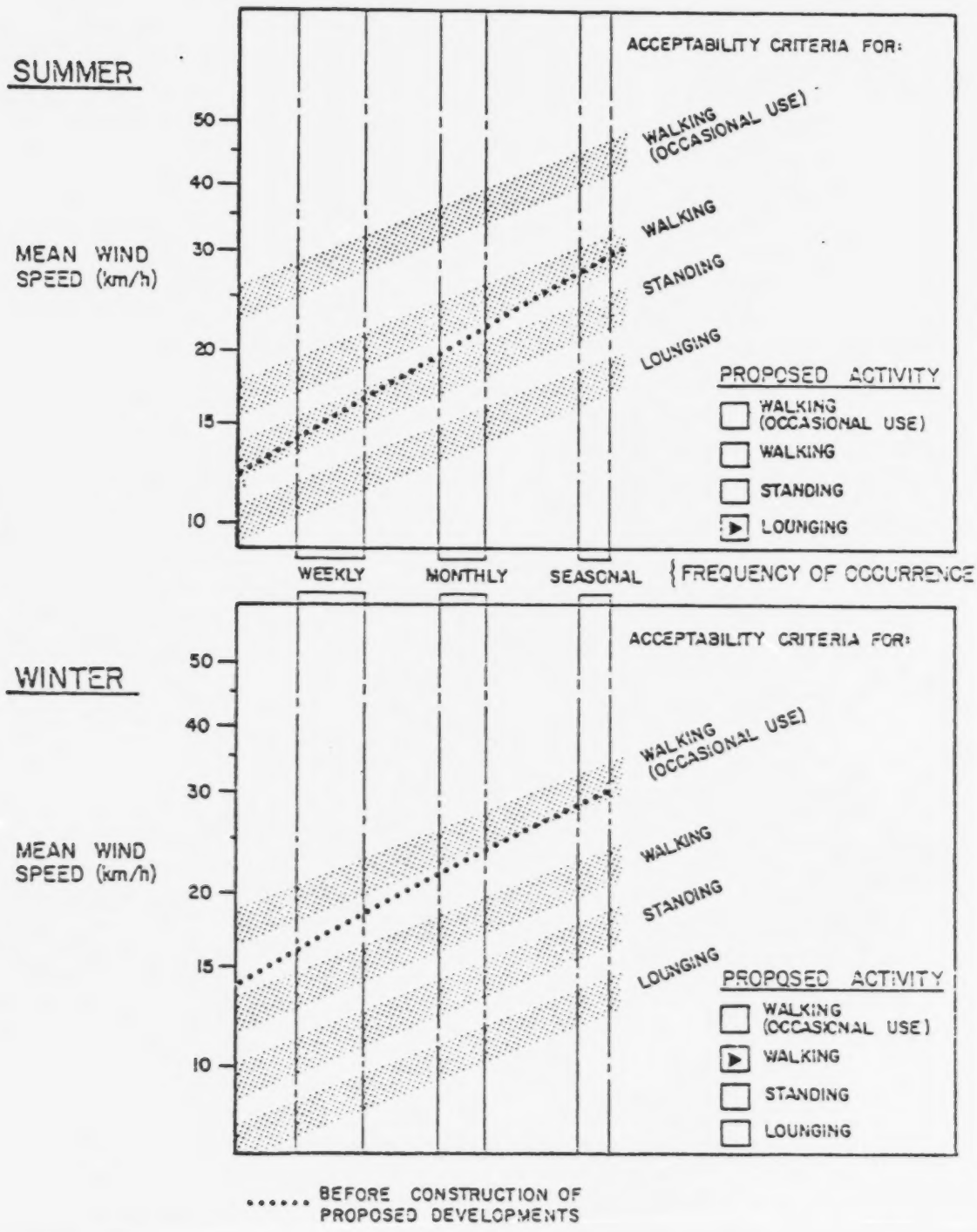
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (43)



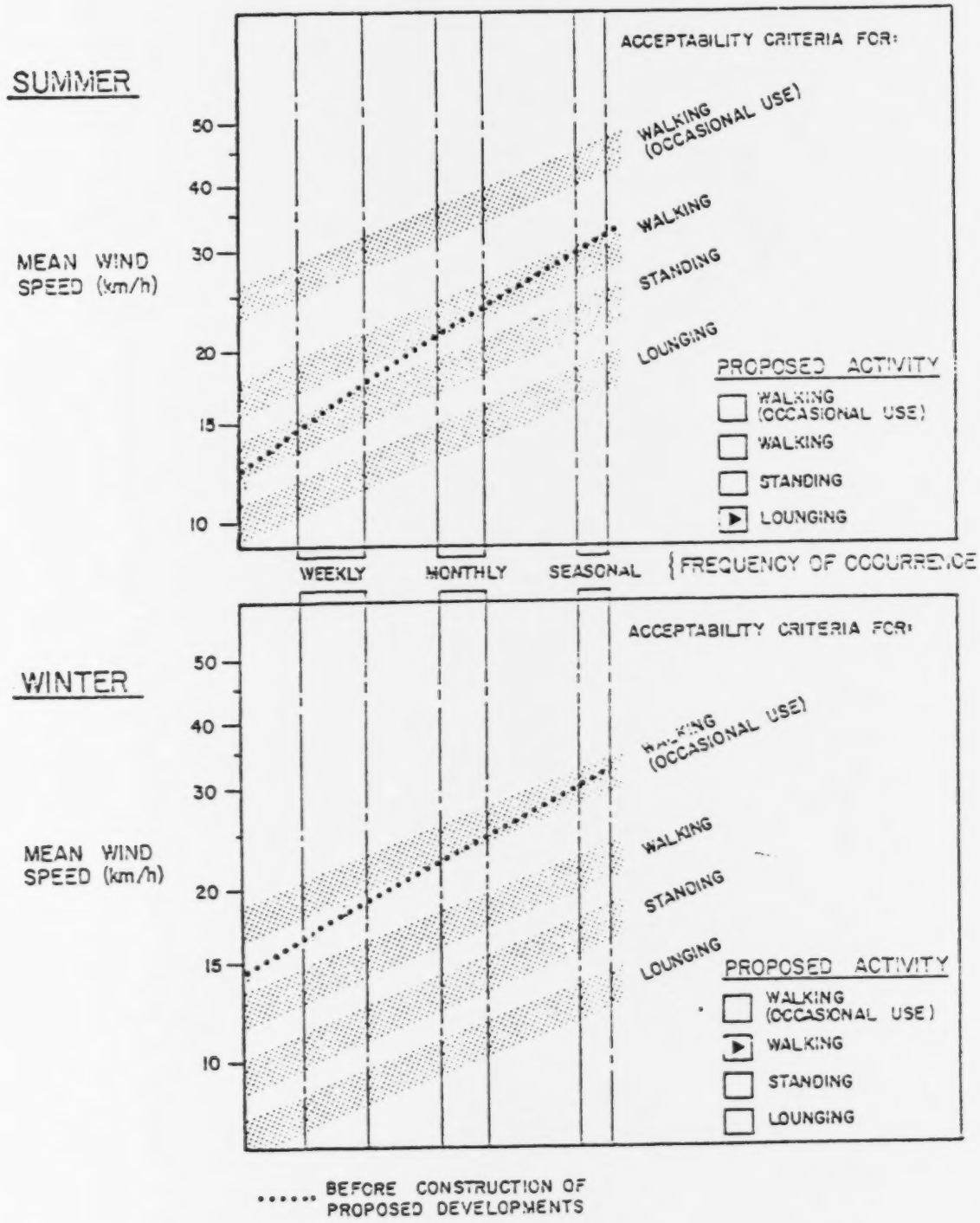
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (44)



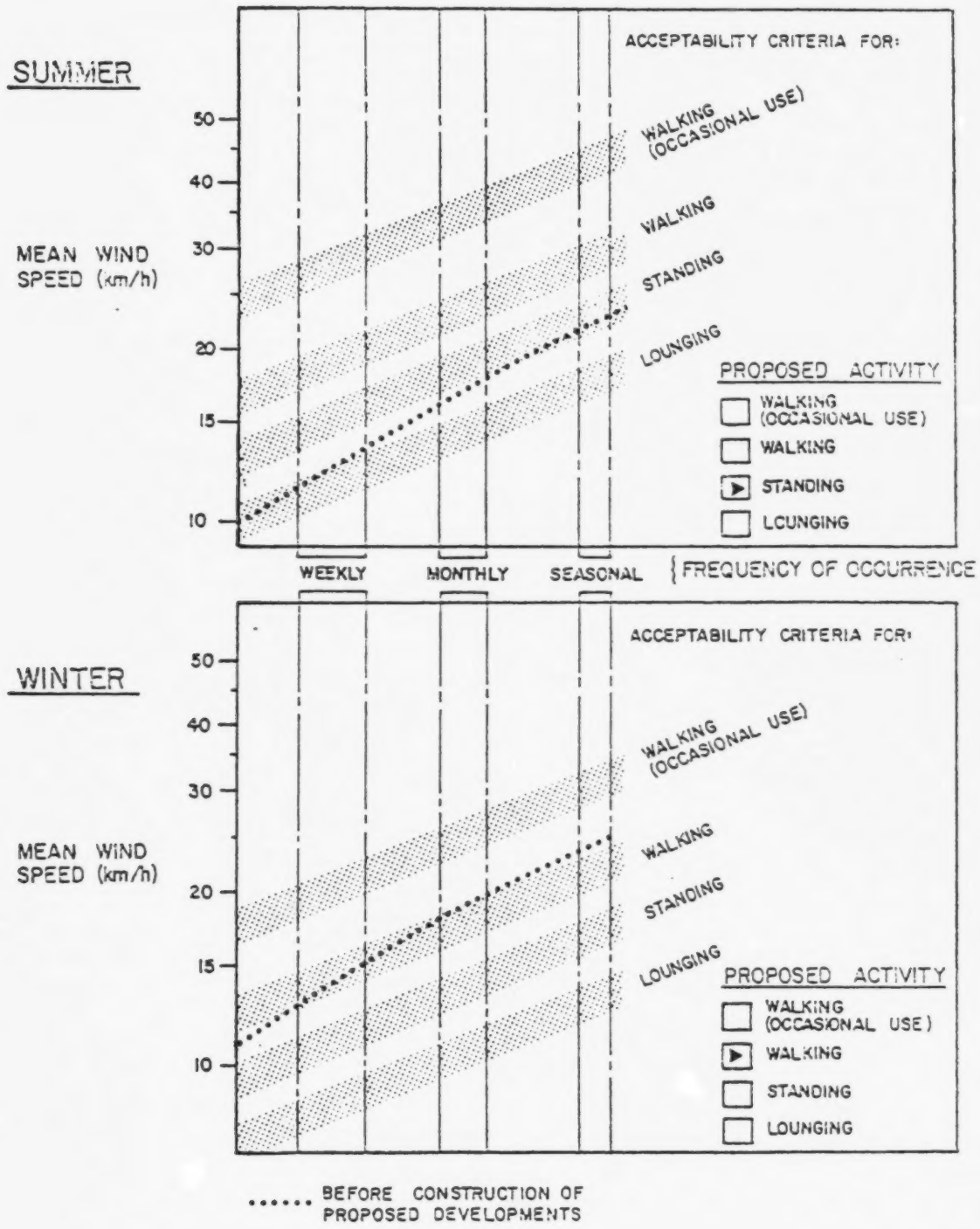
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (45)



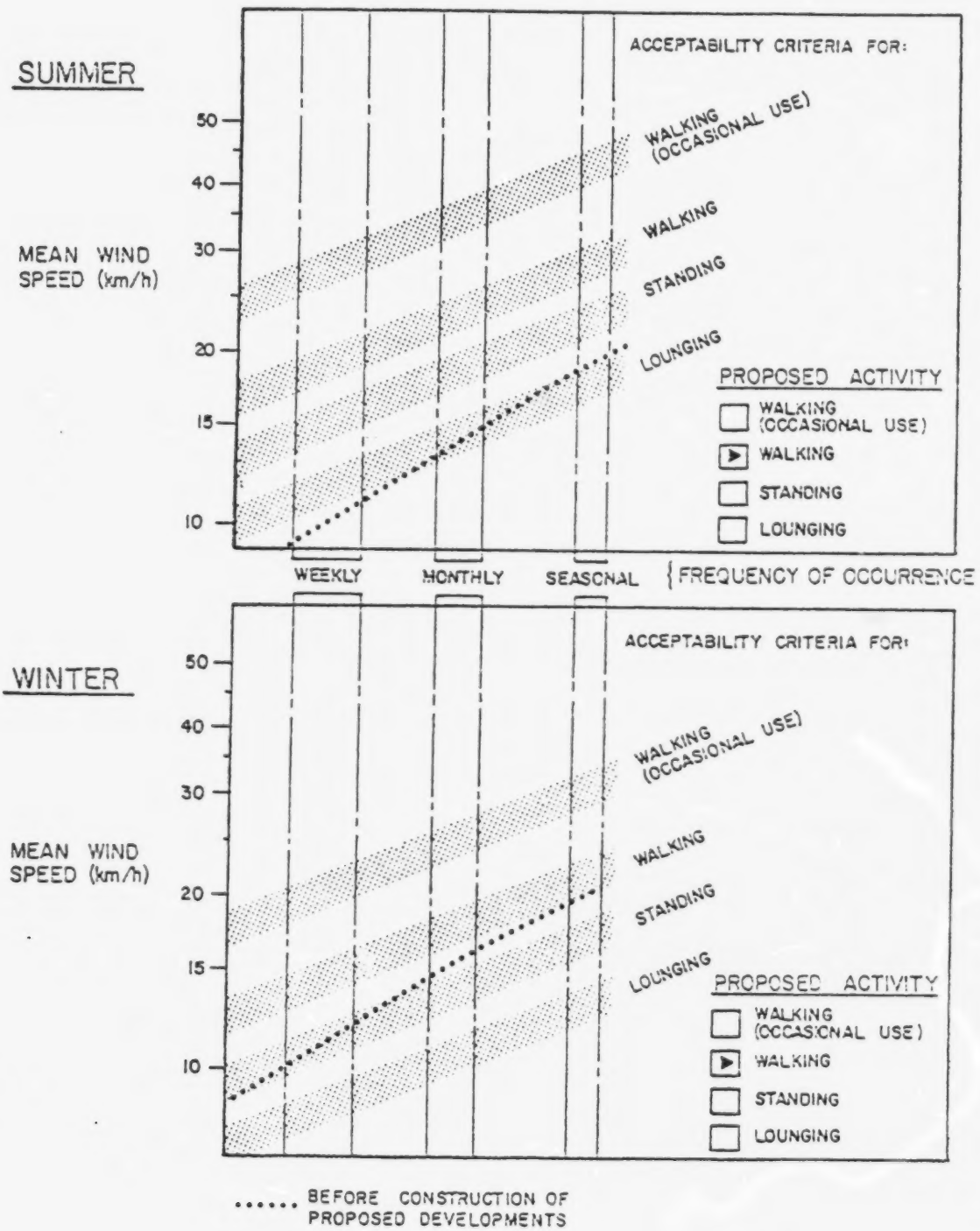
NOTE: THE MEAN WND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (46)



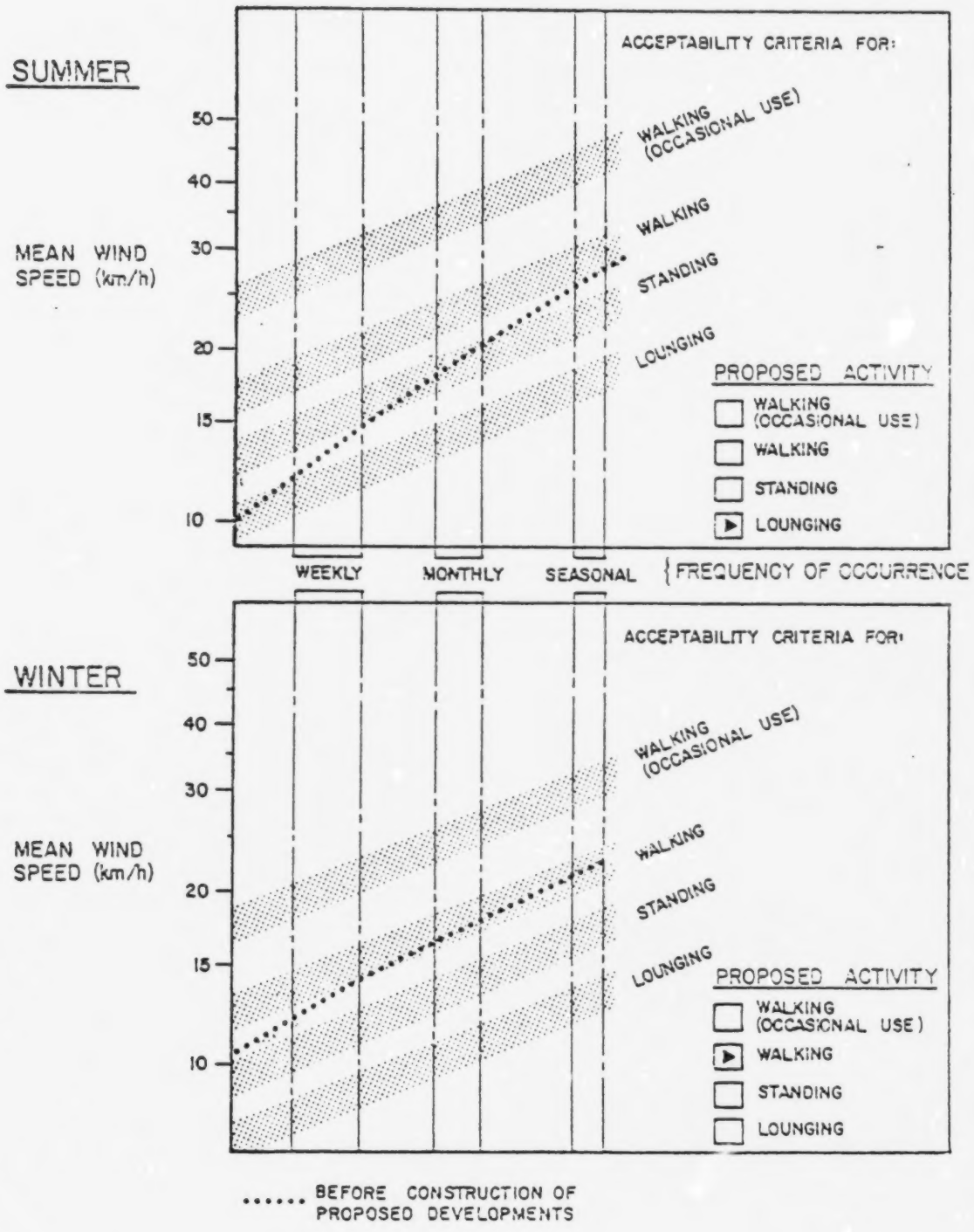
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (47)



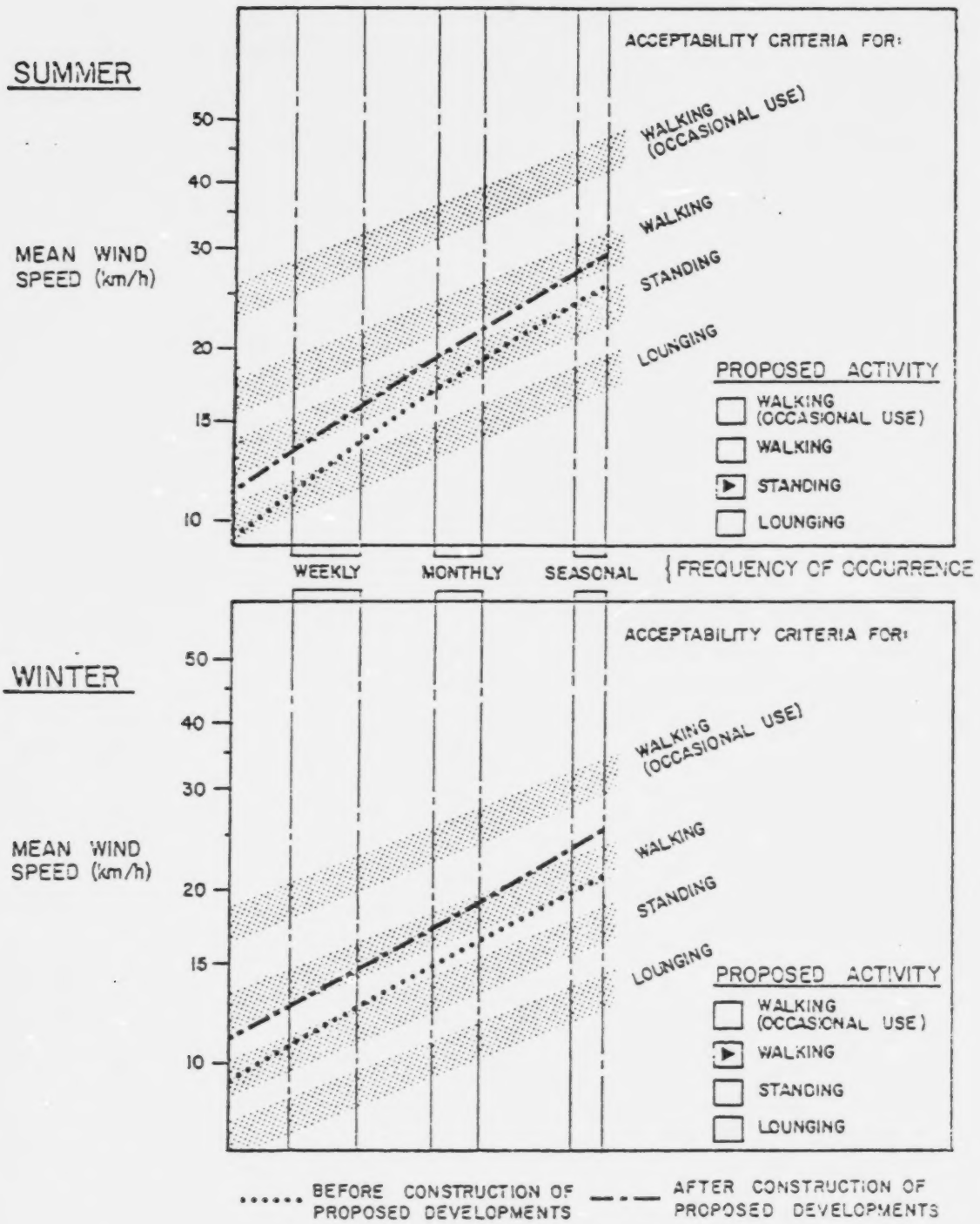
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (48)



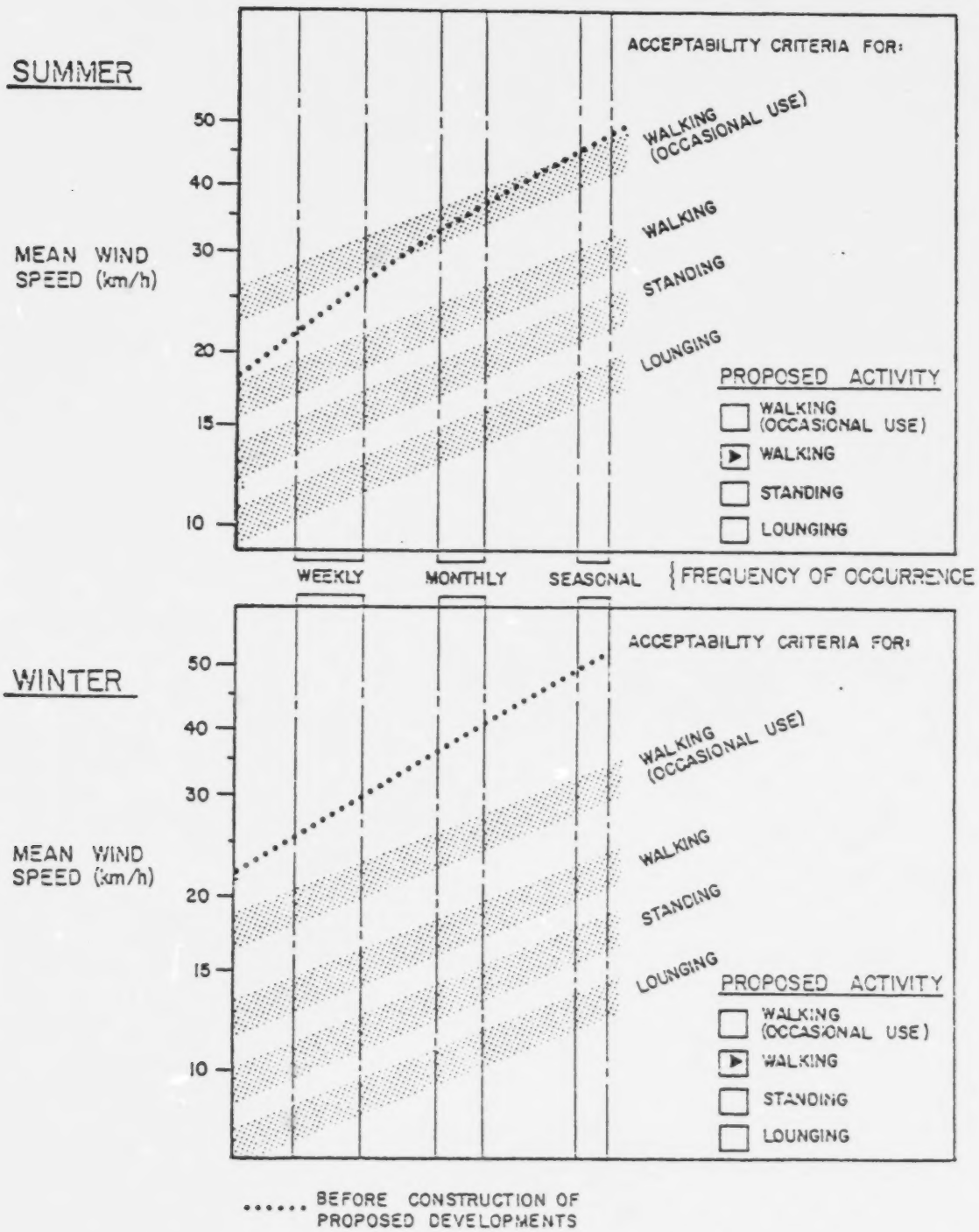
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (49)



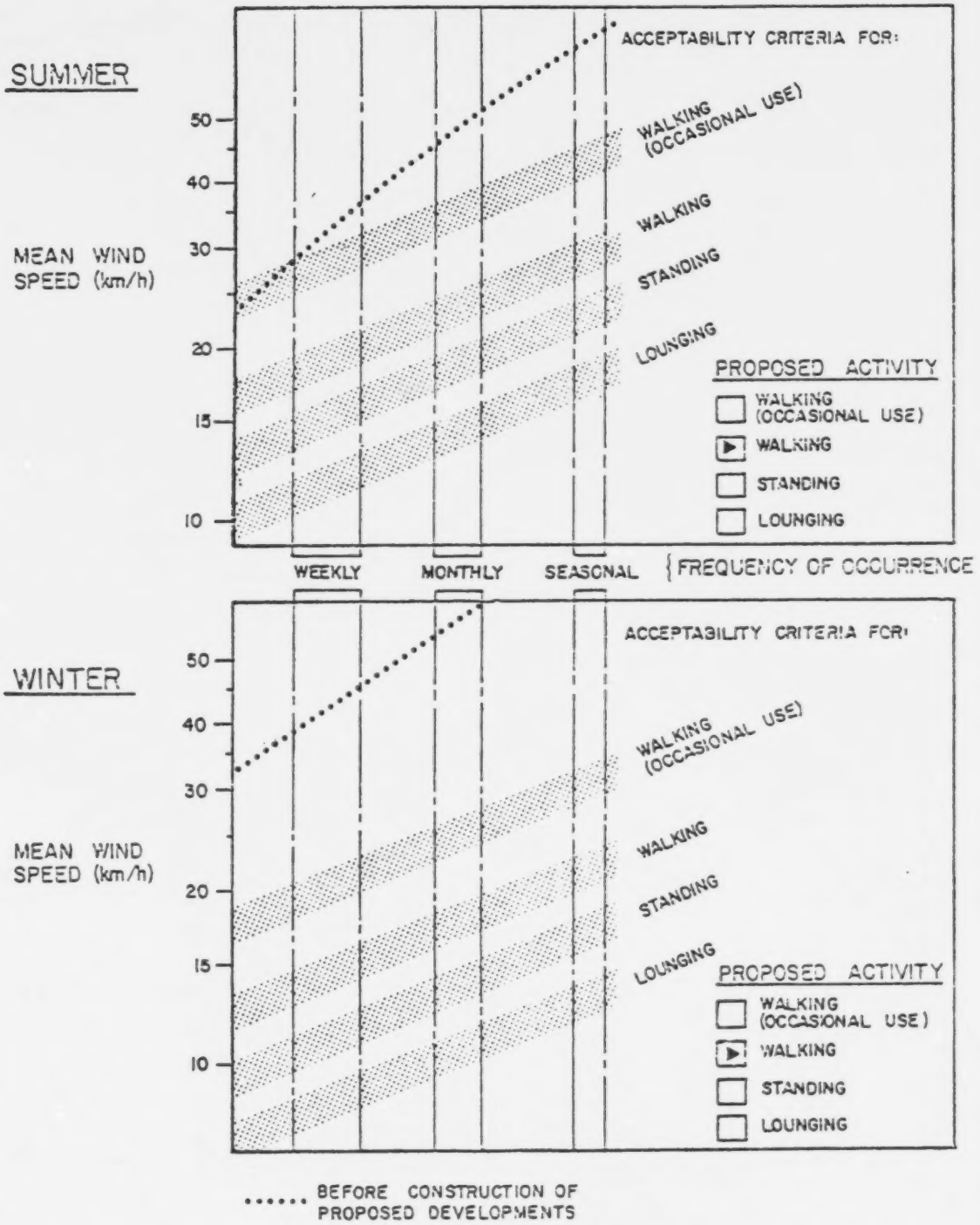
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (50)



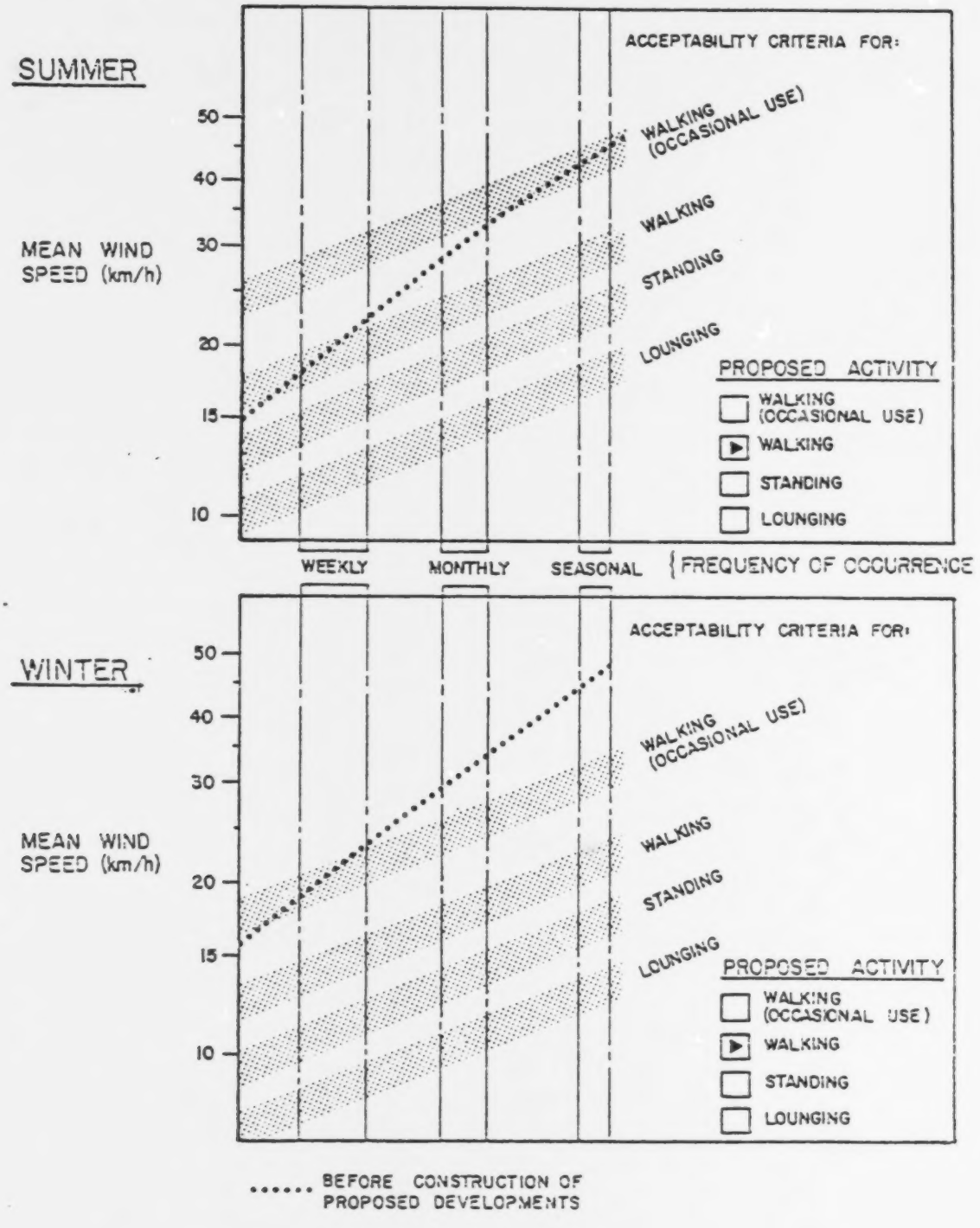
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (51)



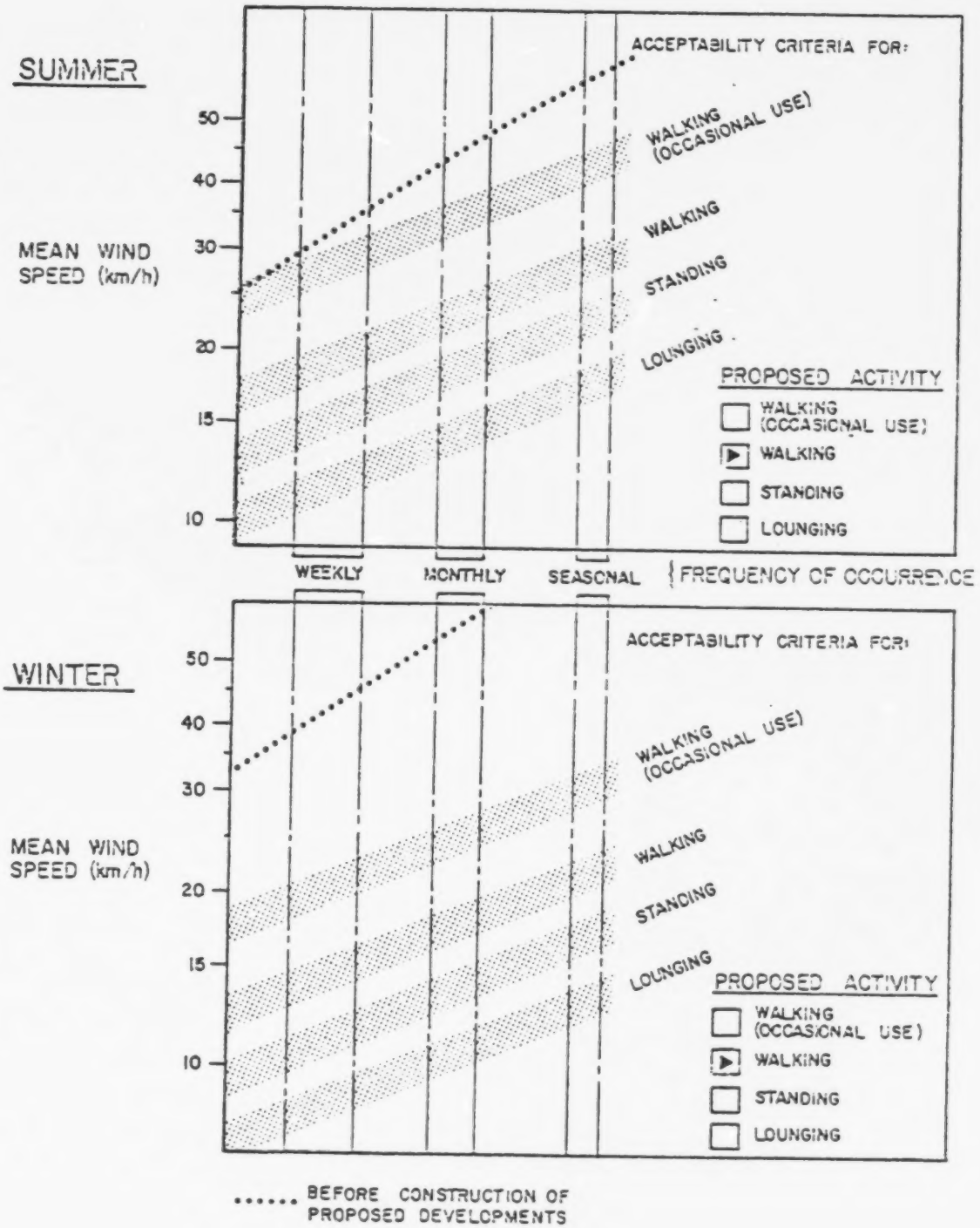
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (52)



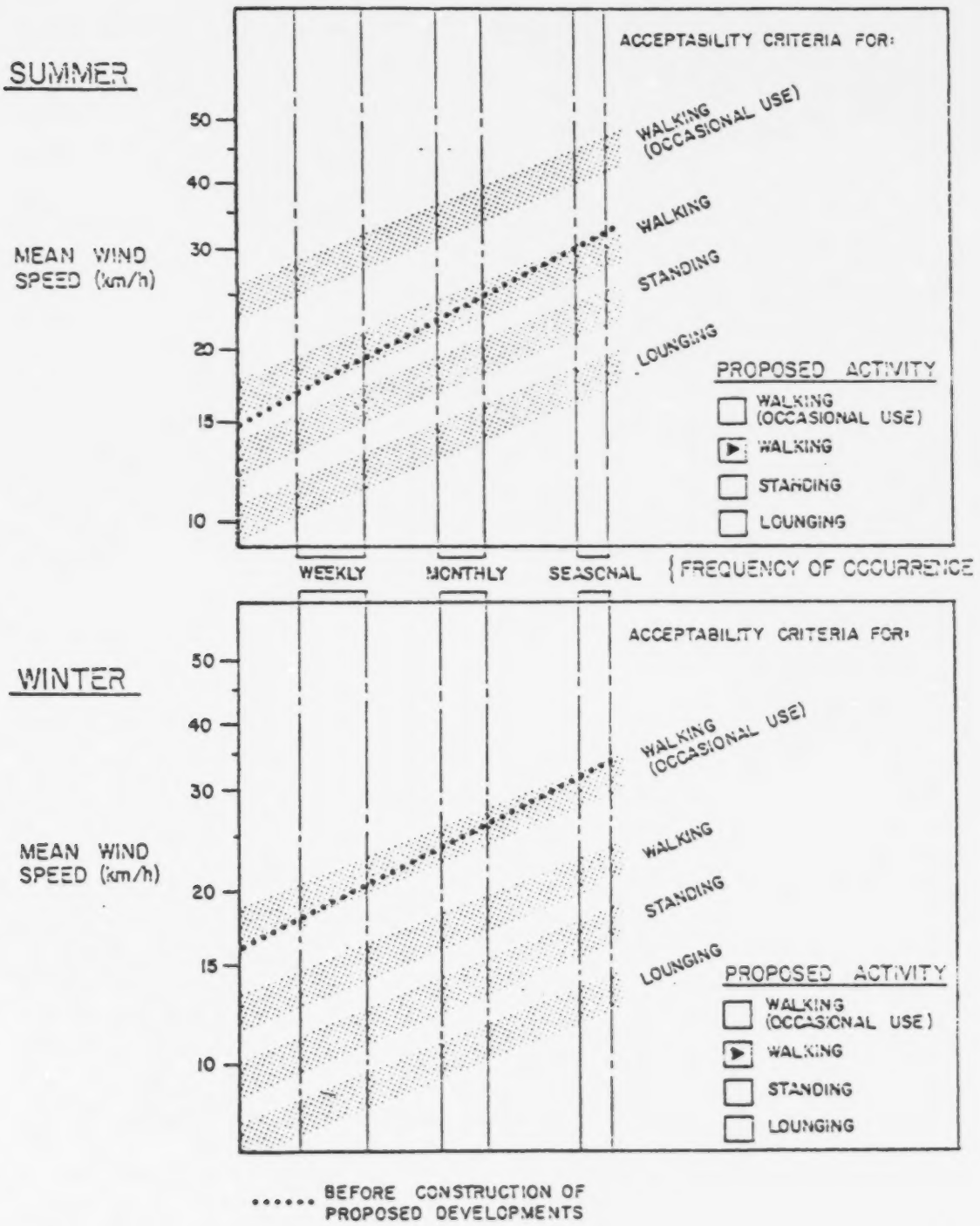
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (53)



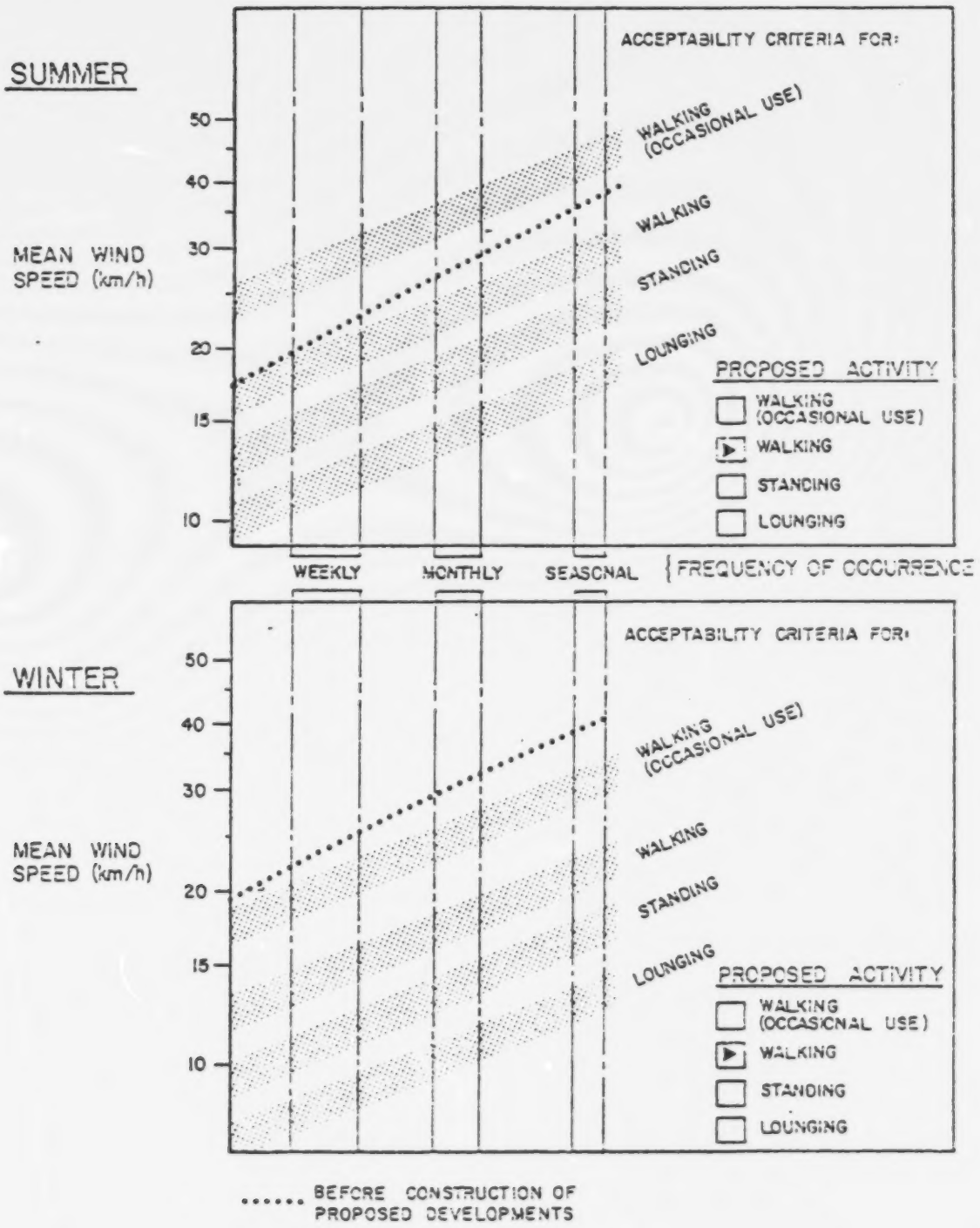
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (54)



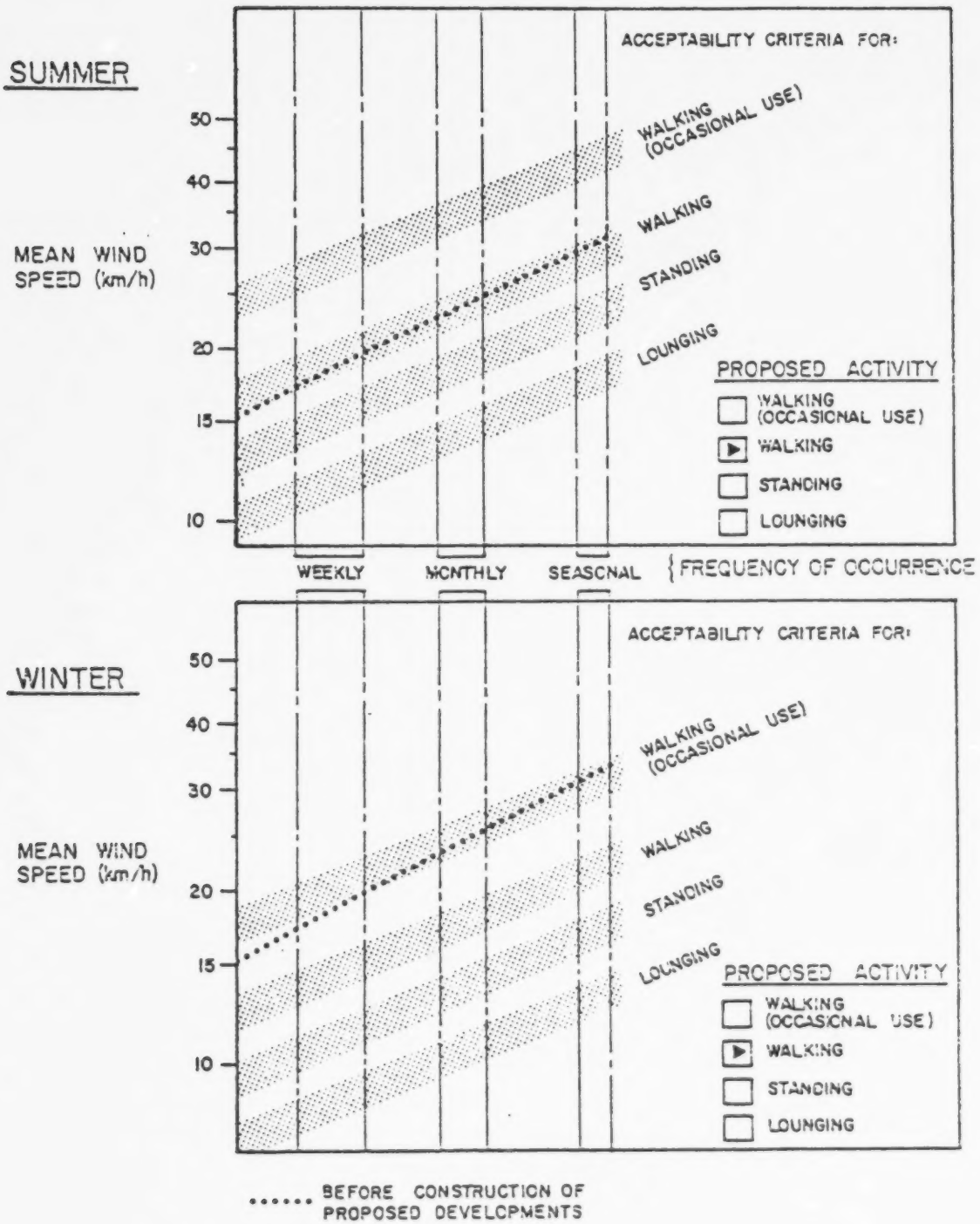
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (55)



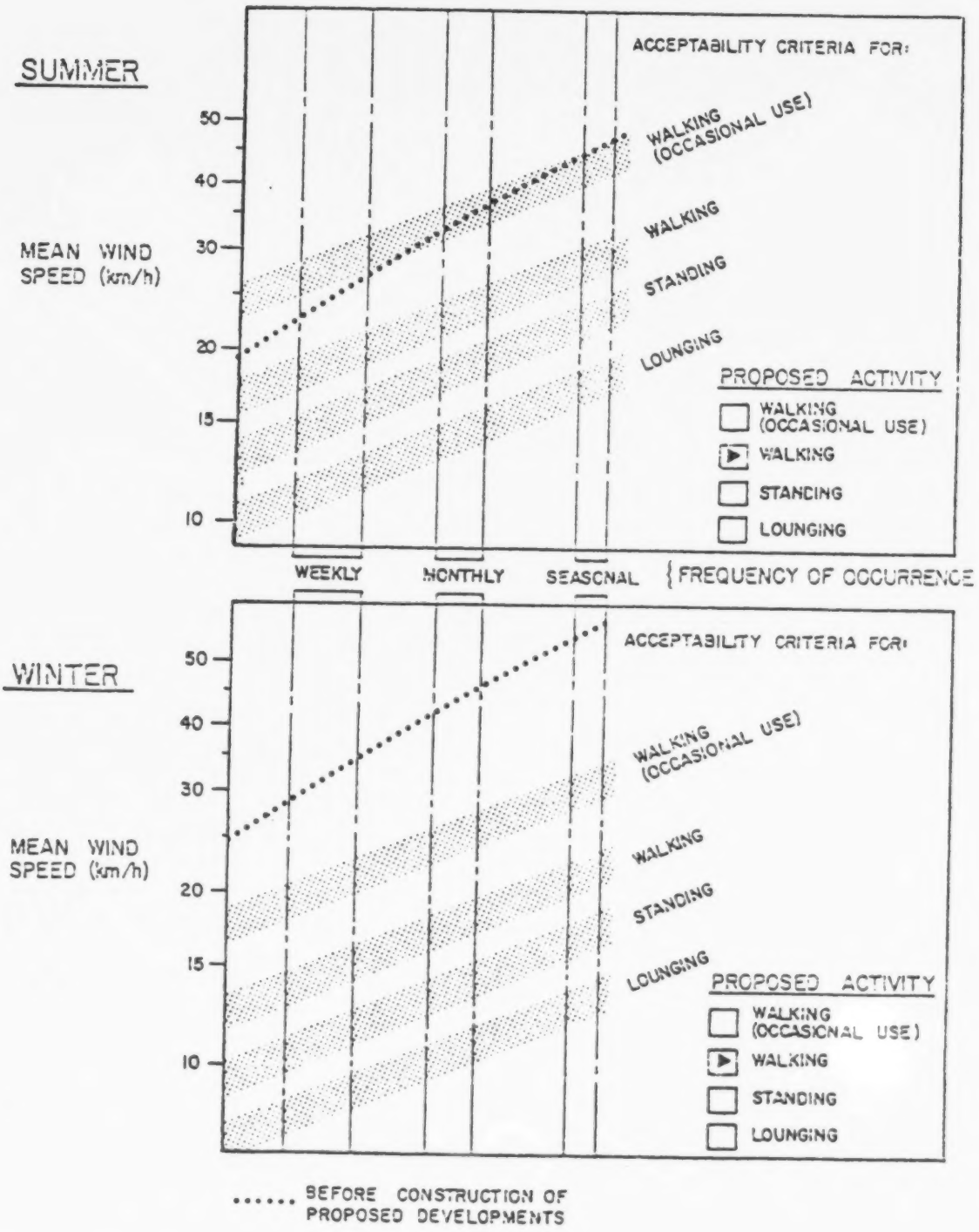
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (56)



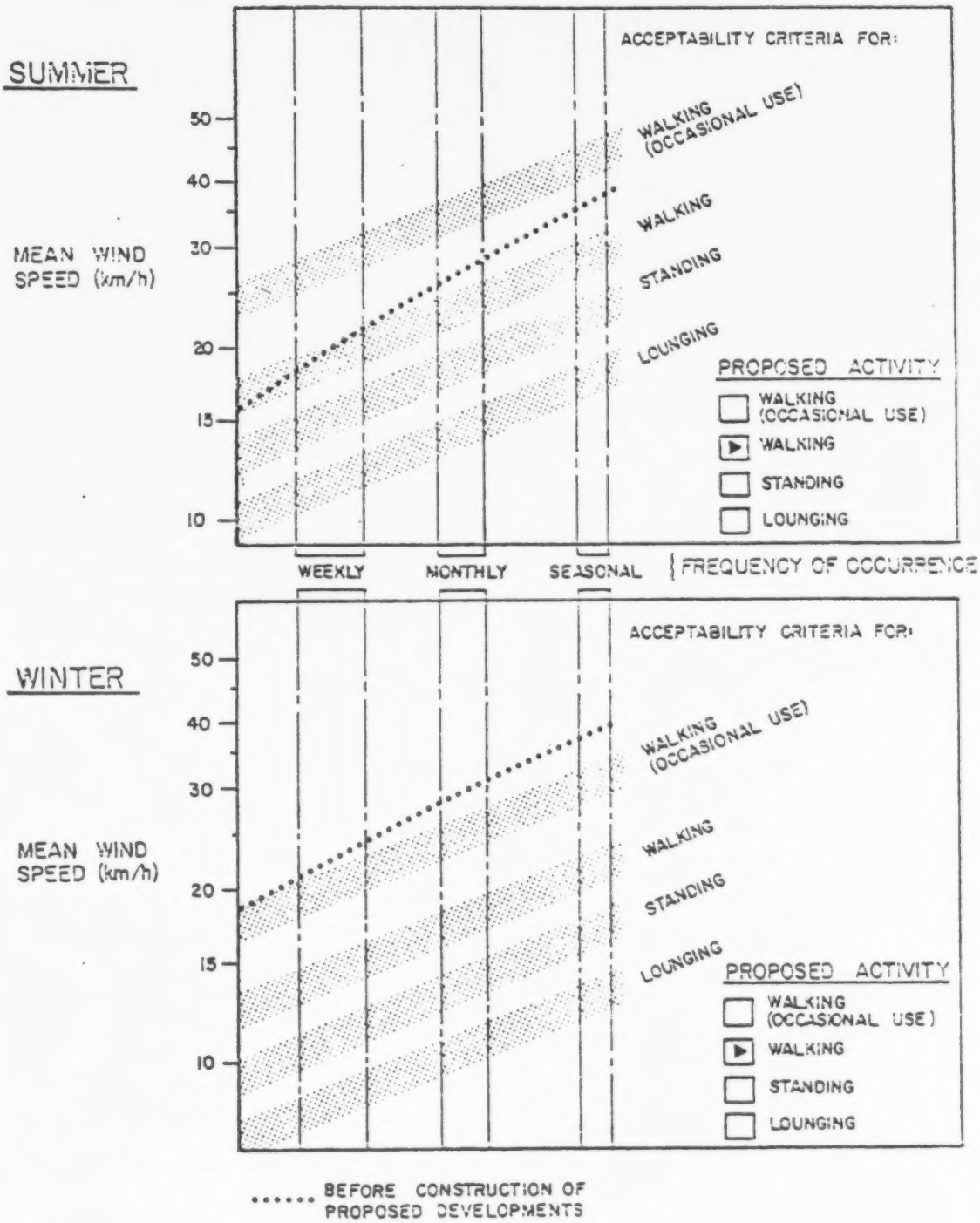
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (57)



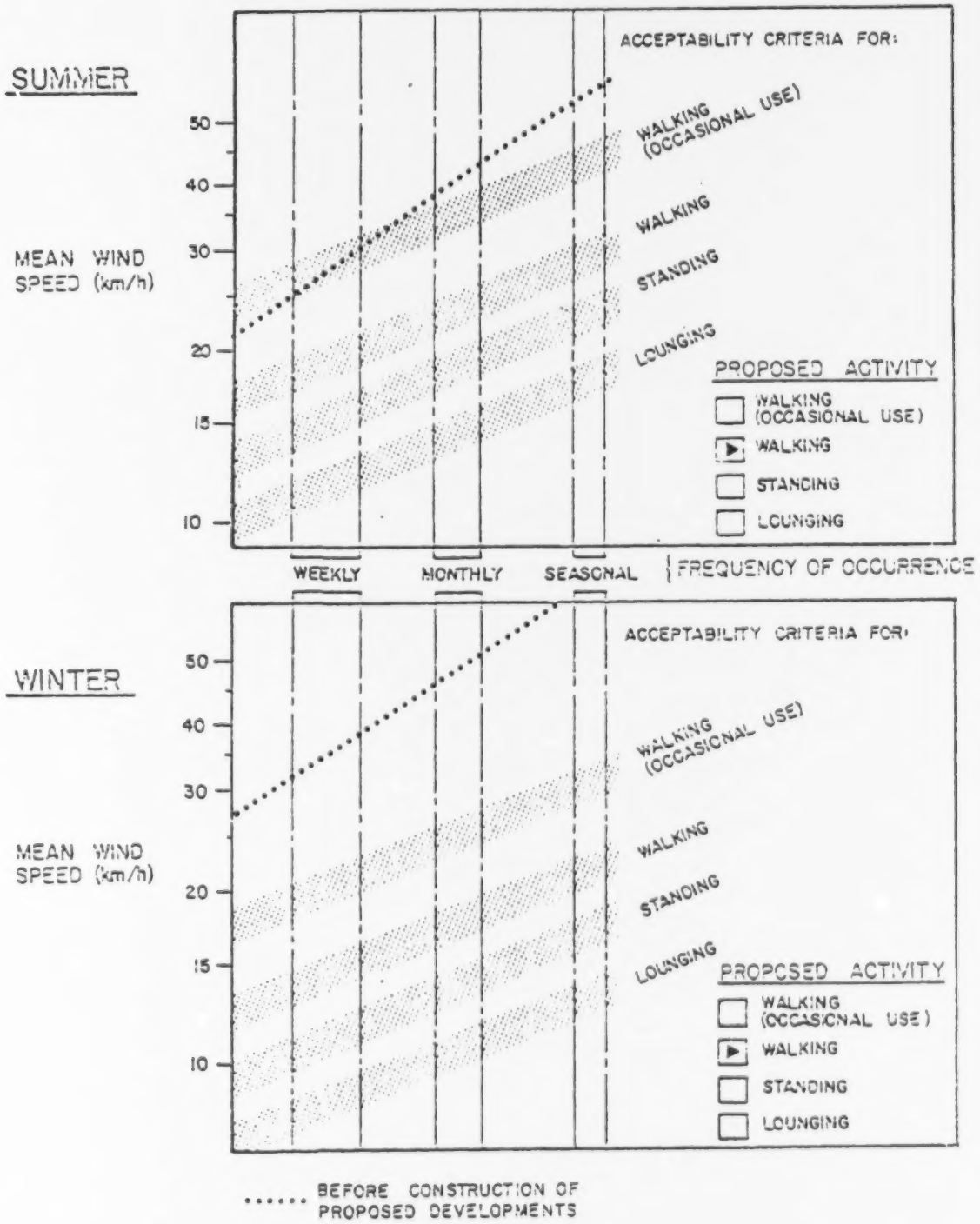
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (58)



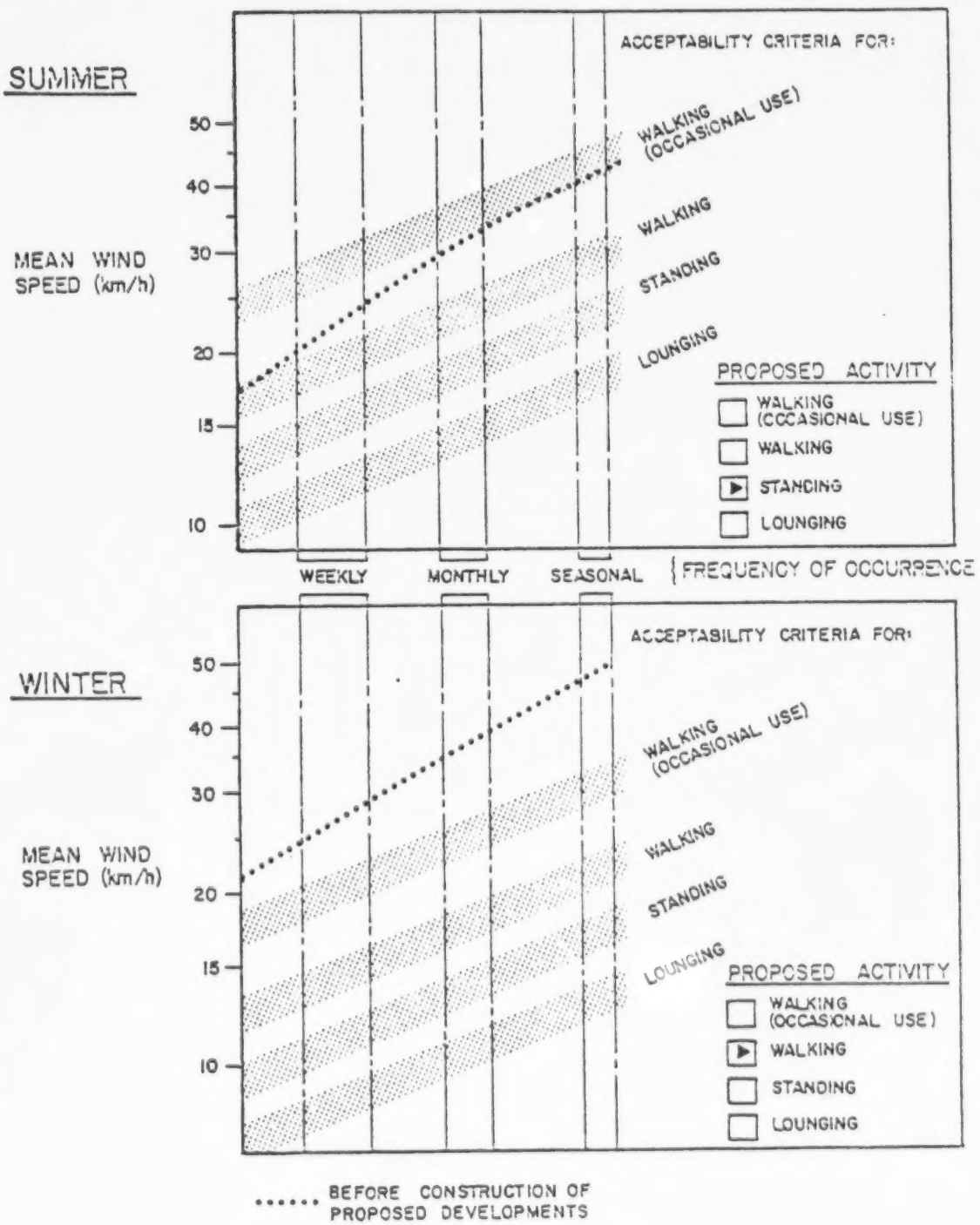
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (59)



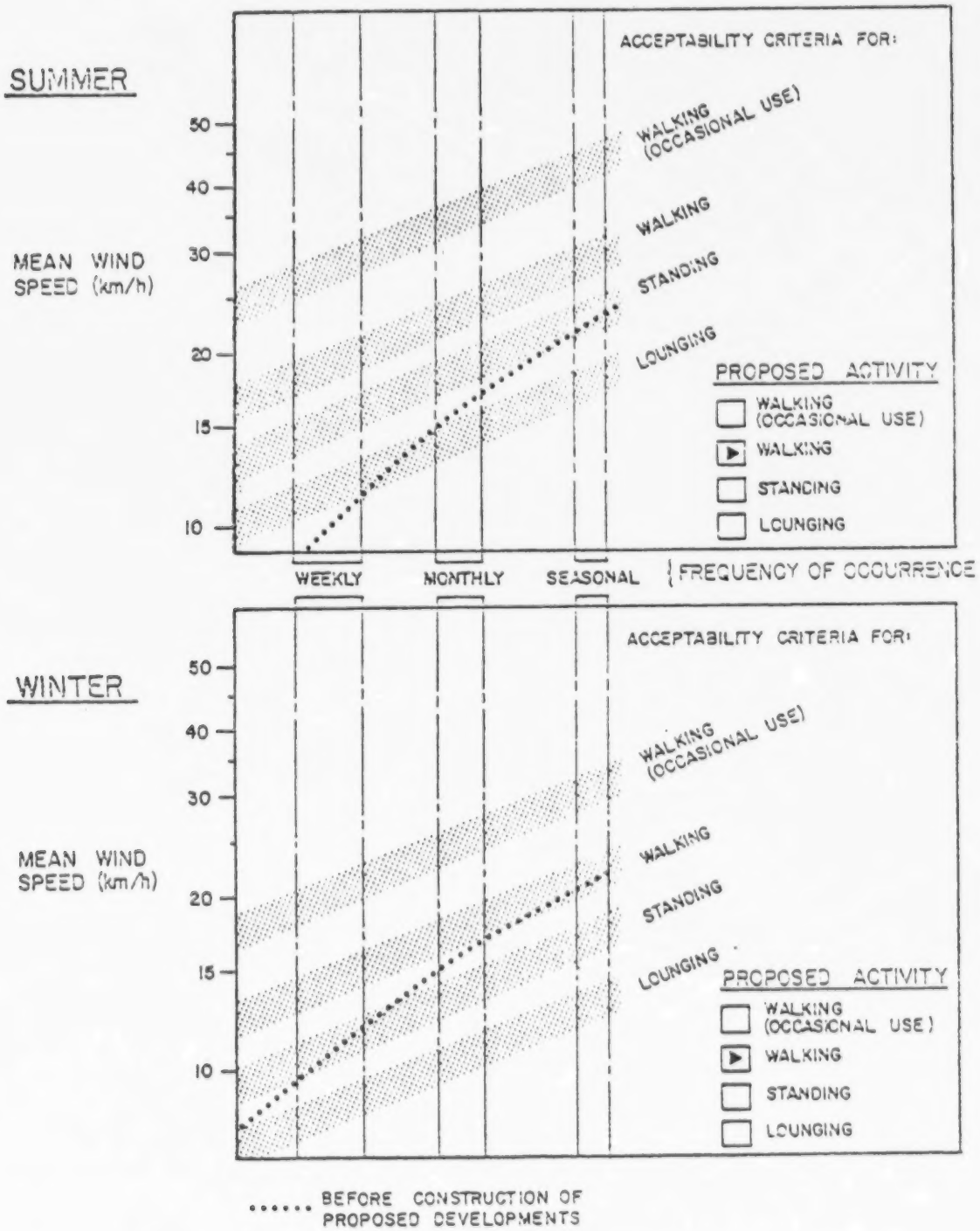
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (60)



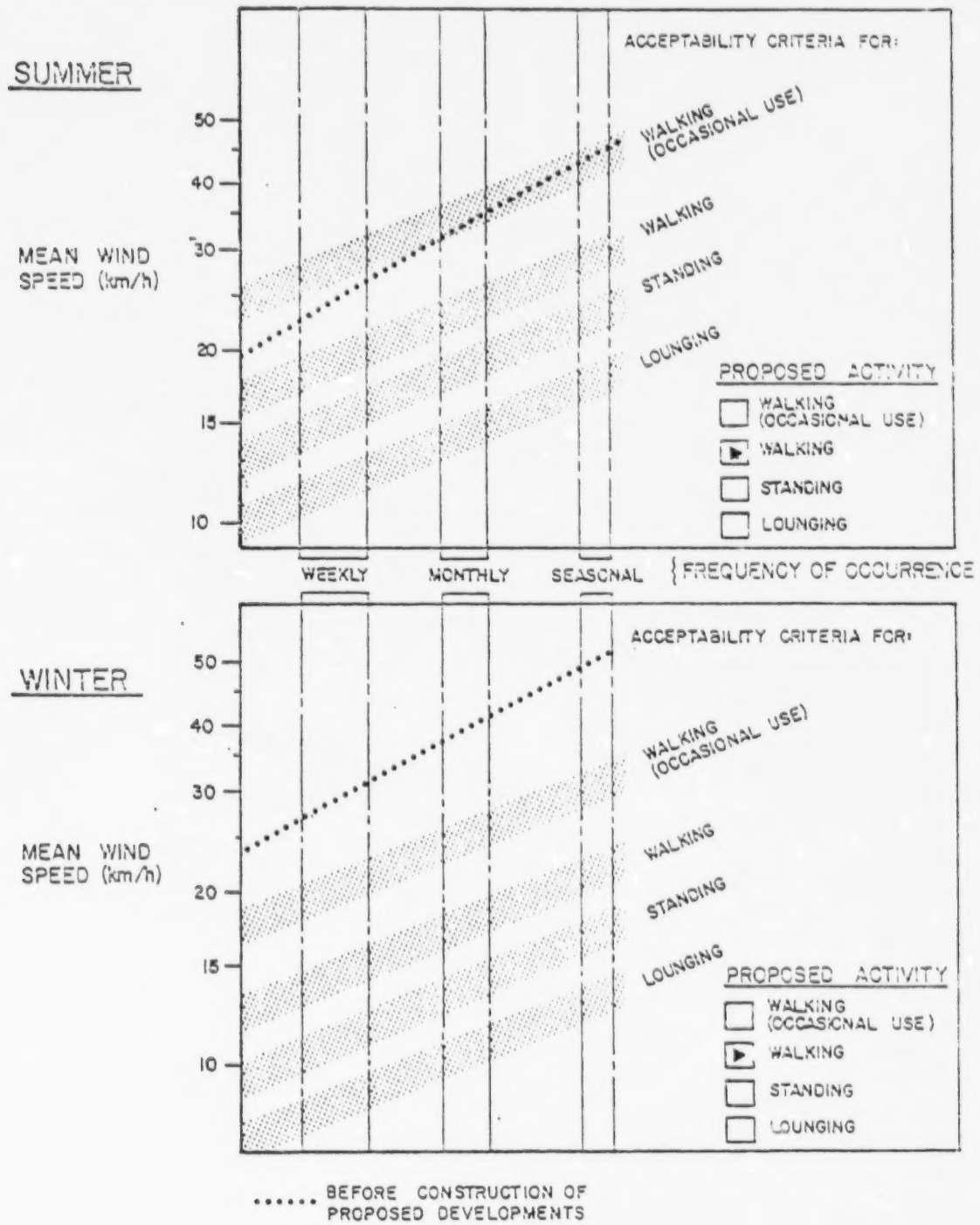
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (61)



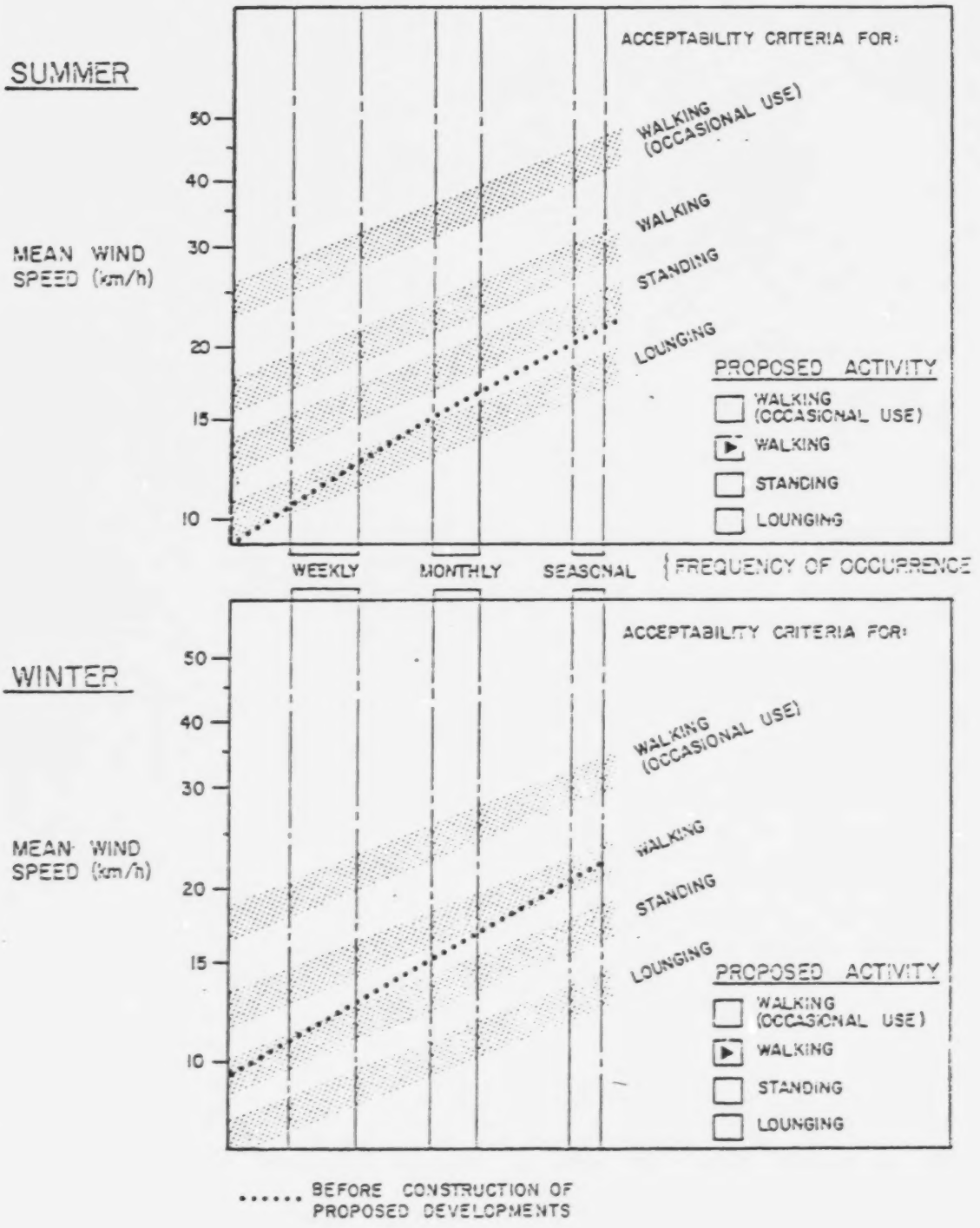
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (62)



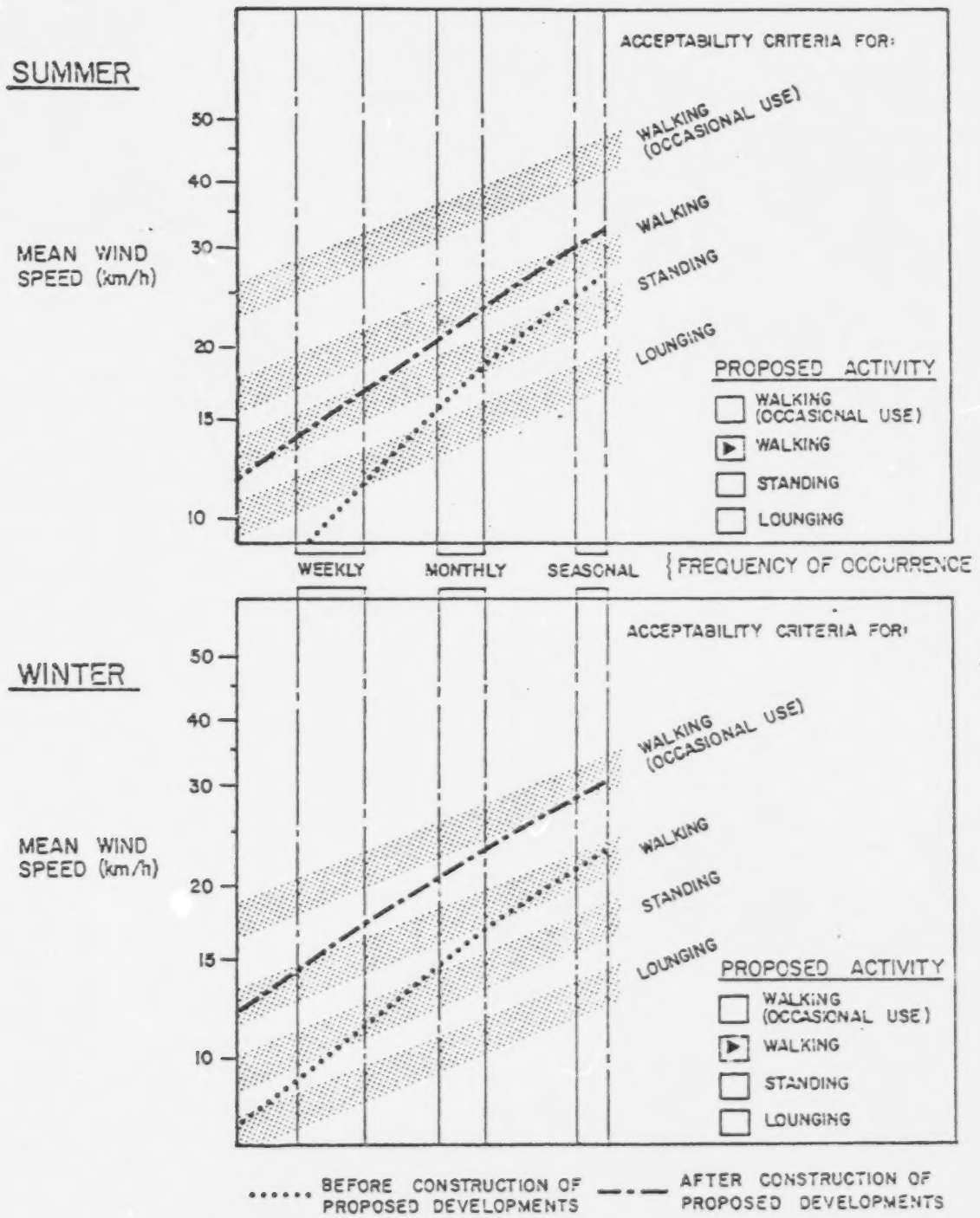
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (63)



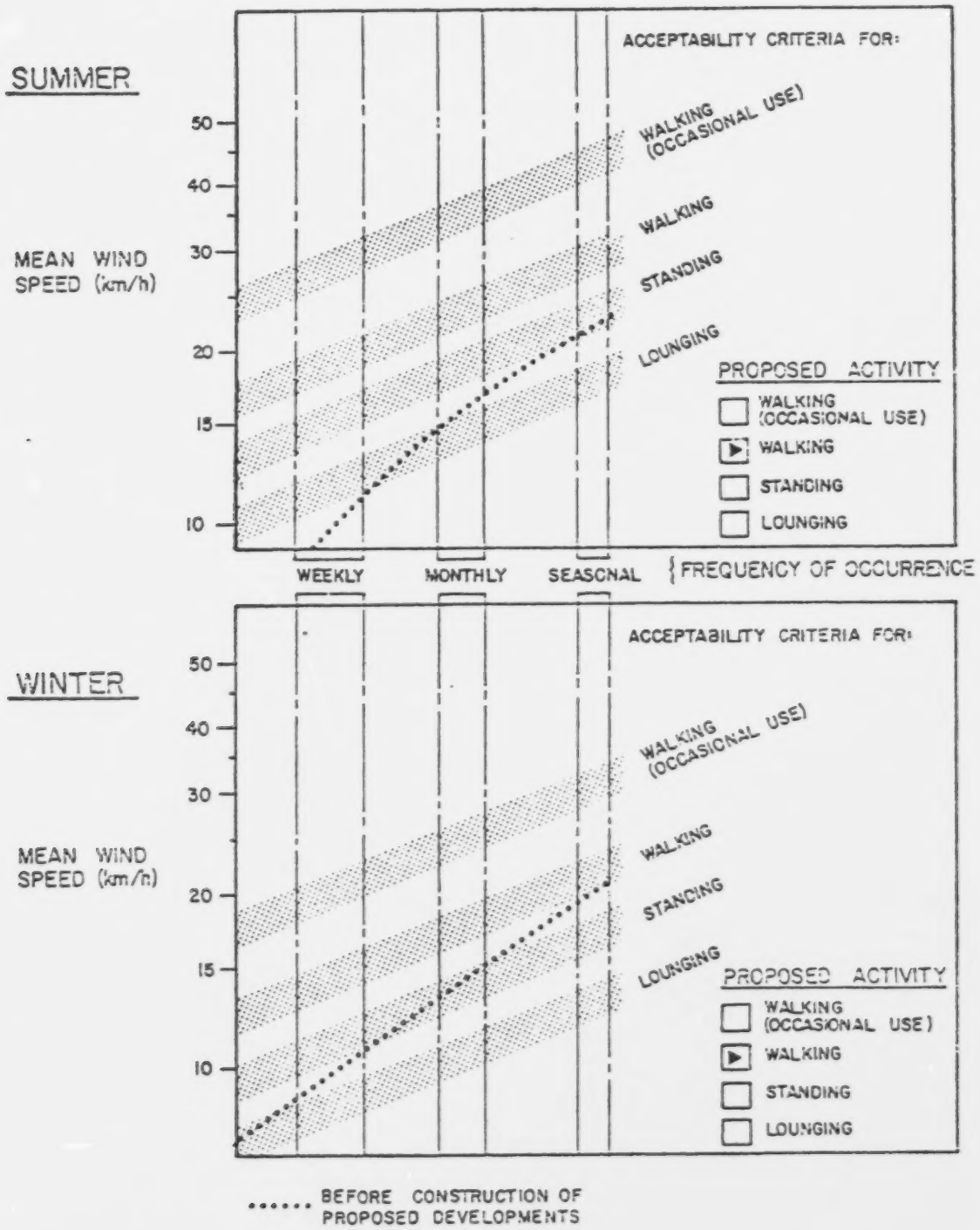
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (64)



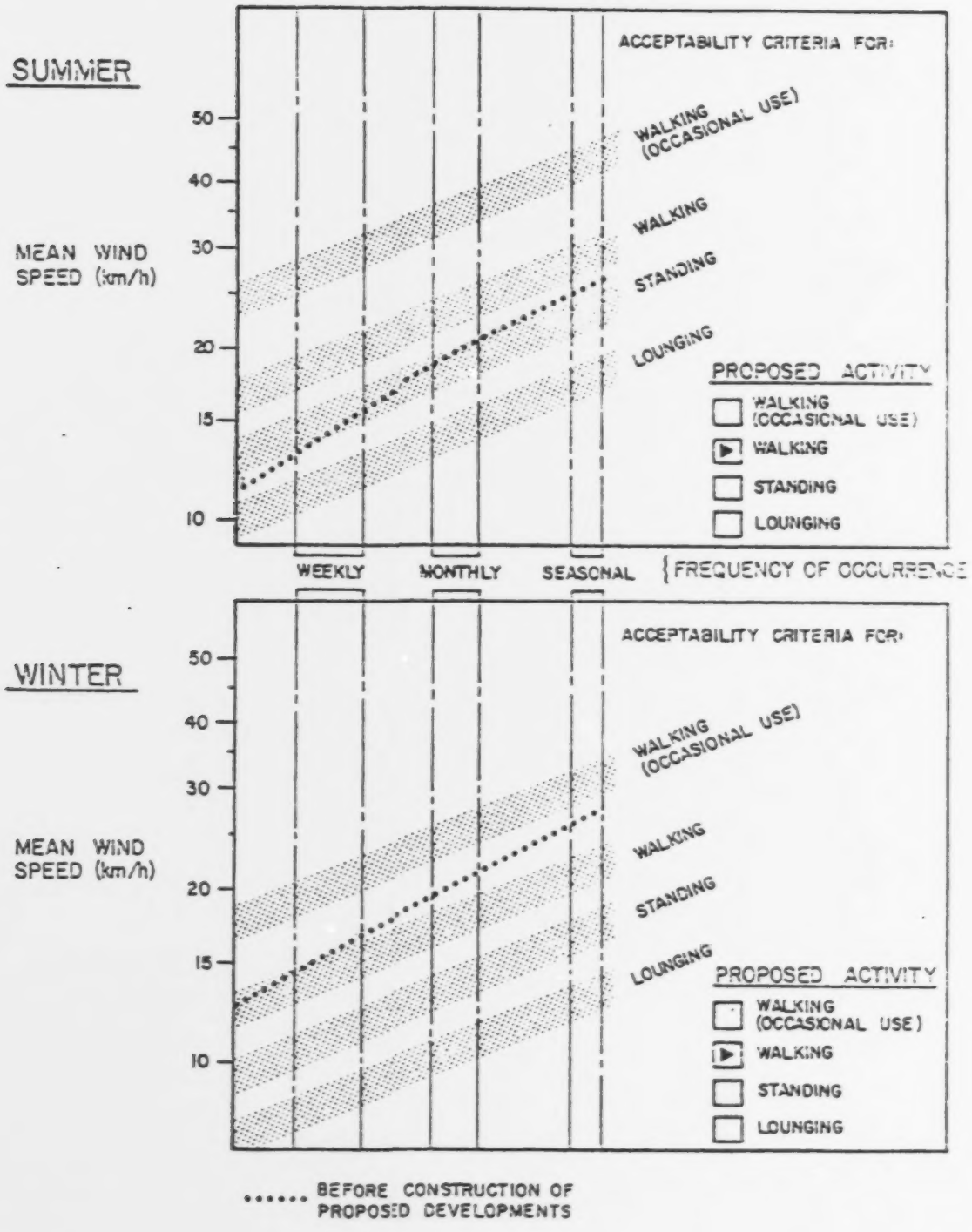
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (65)



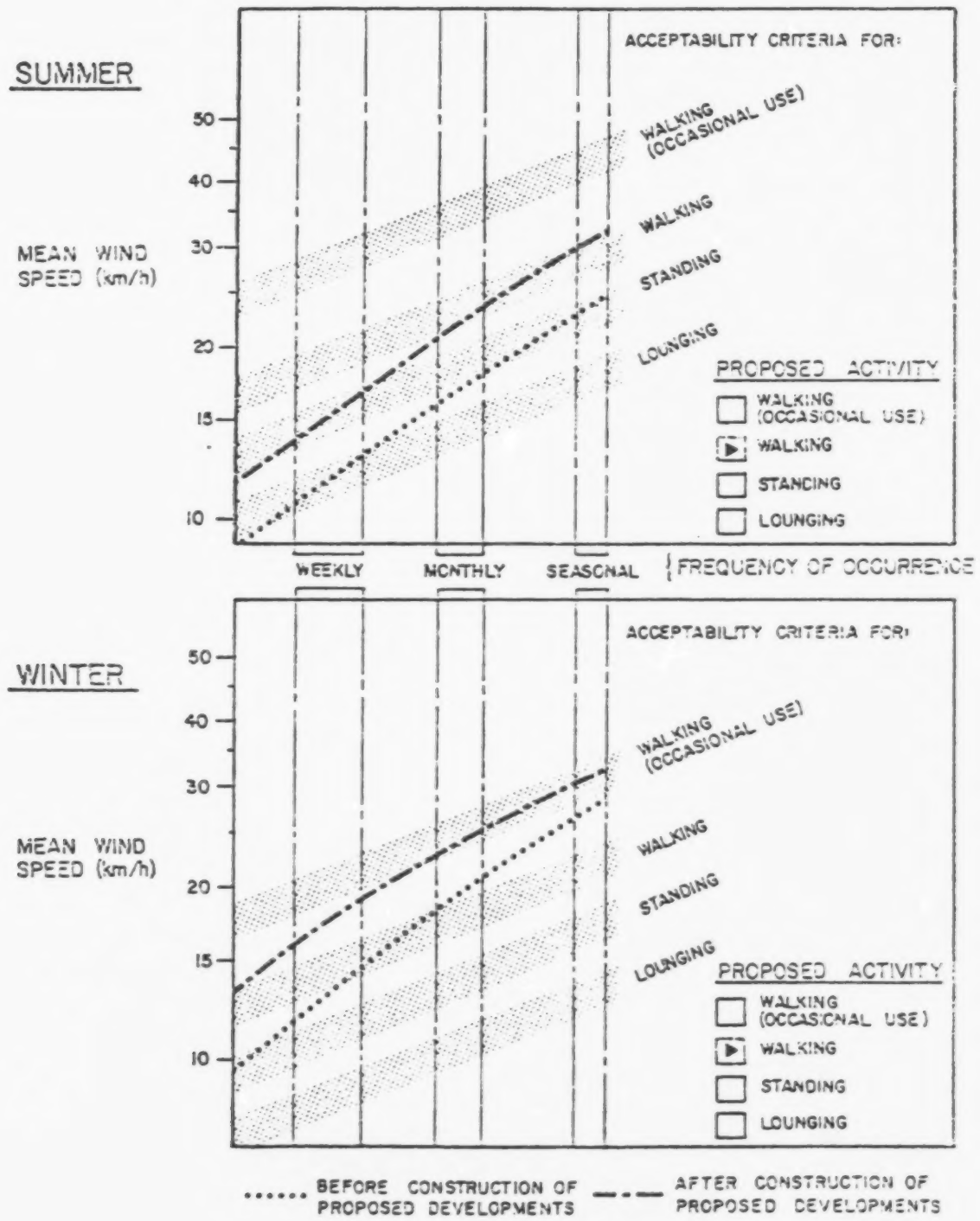
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (66)



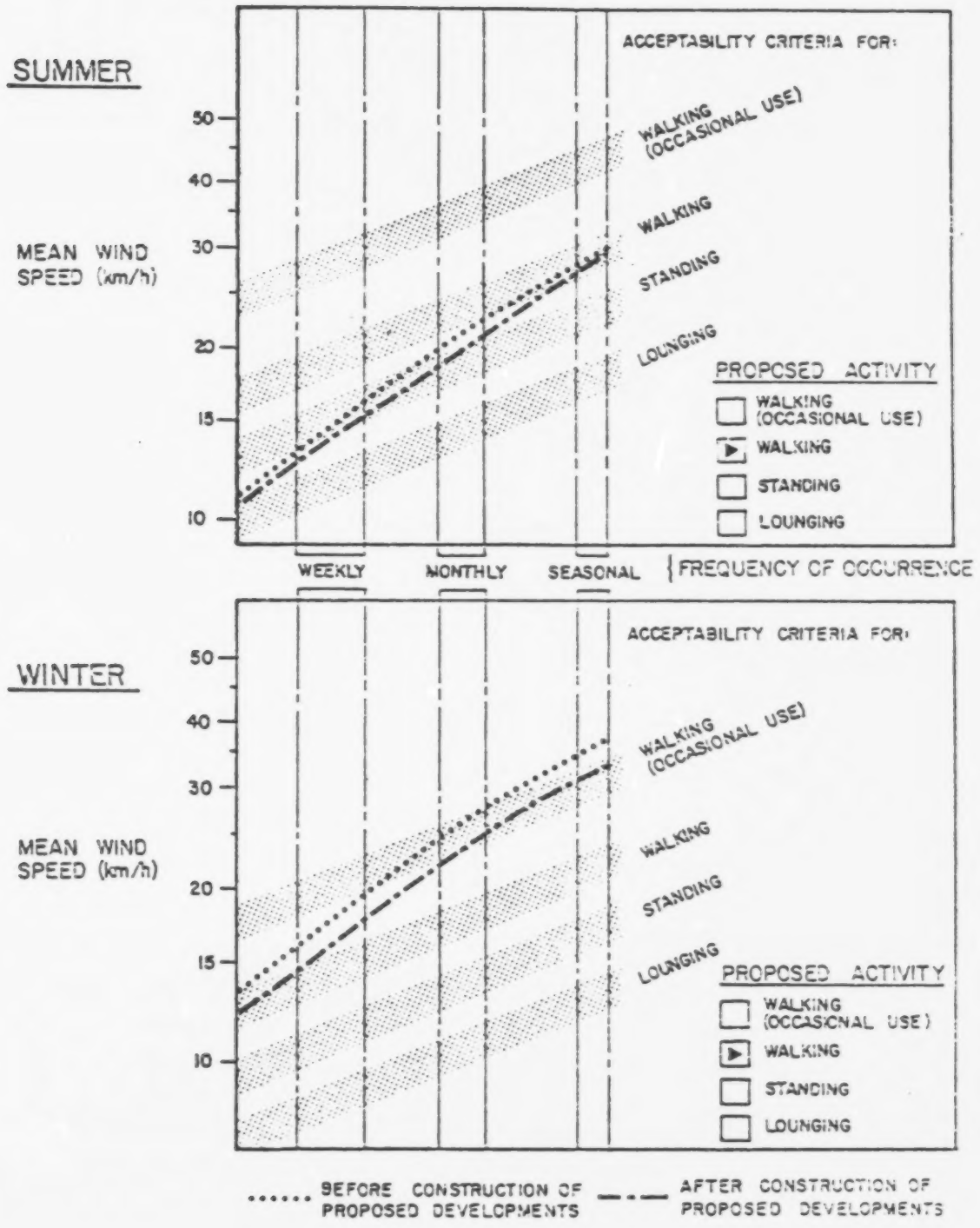
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (67)



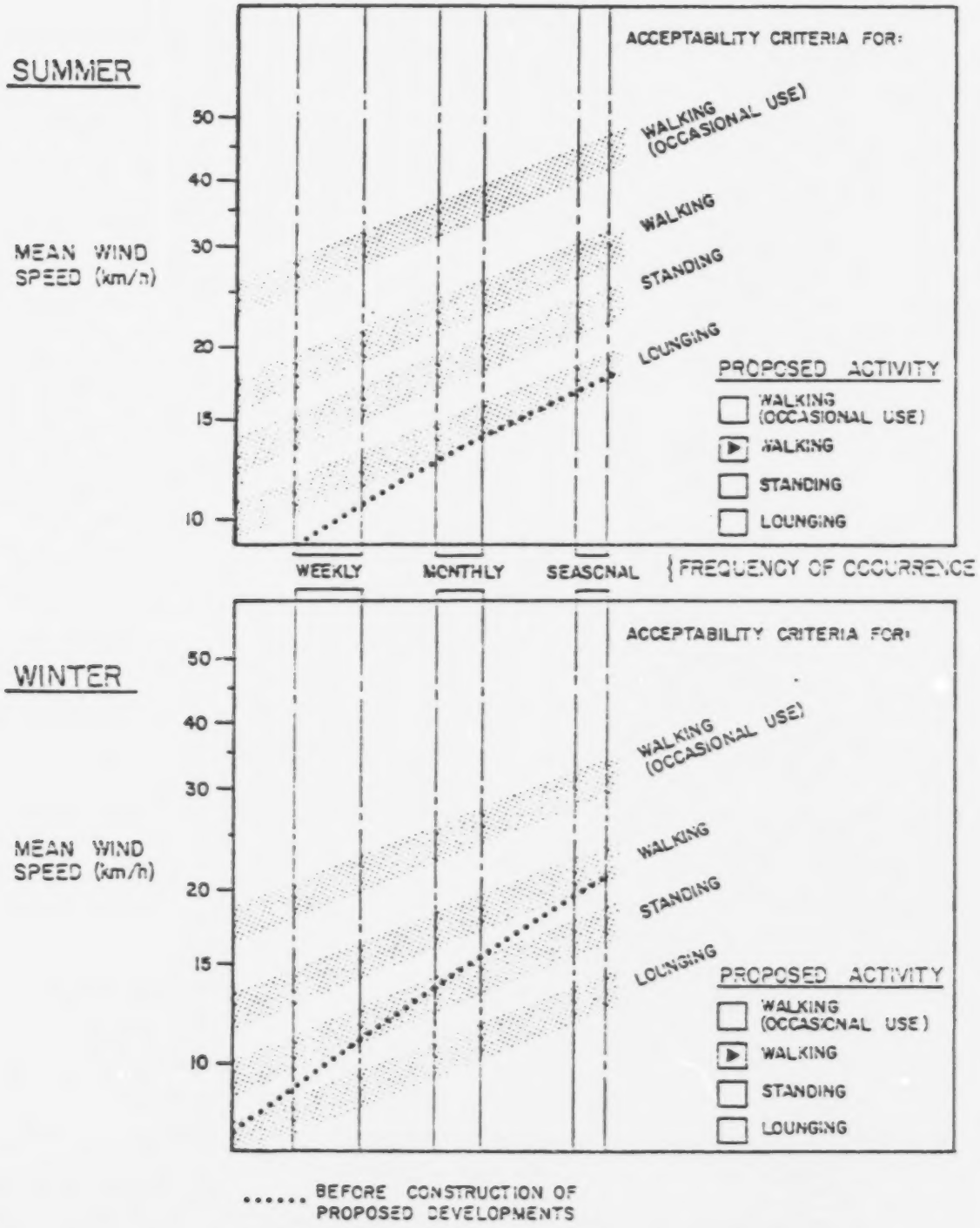
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (68)



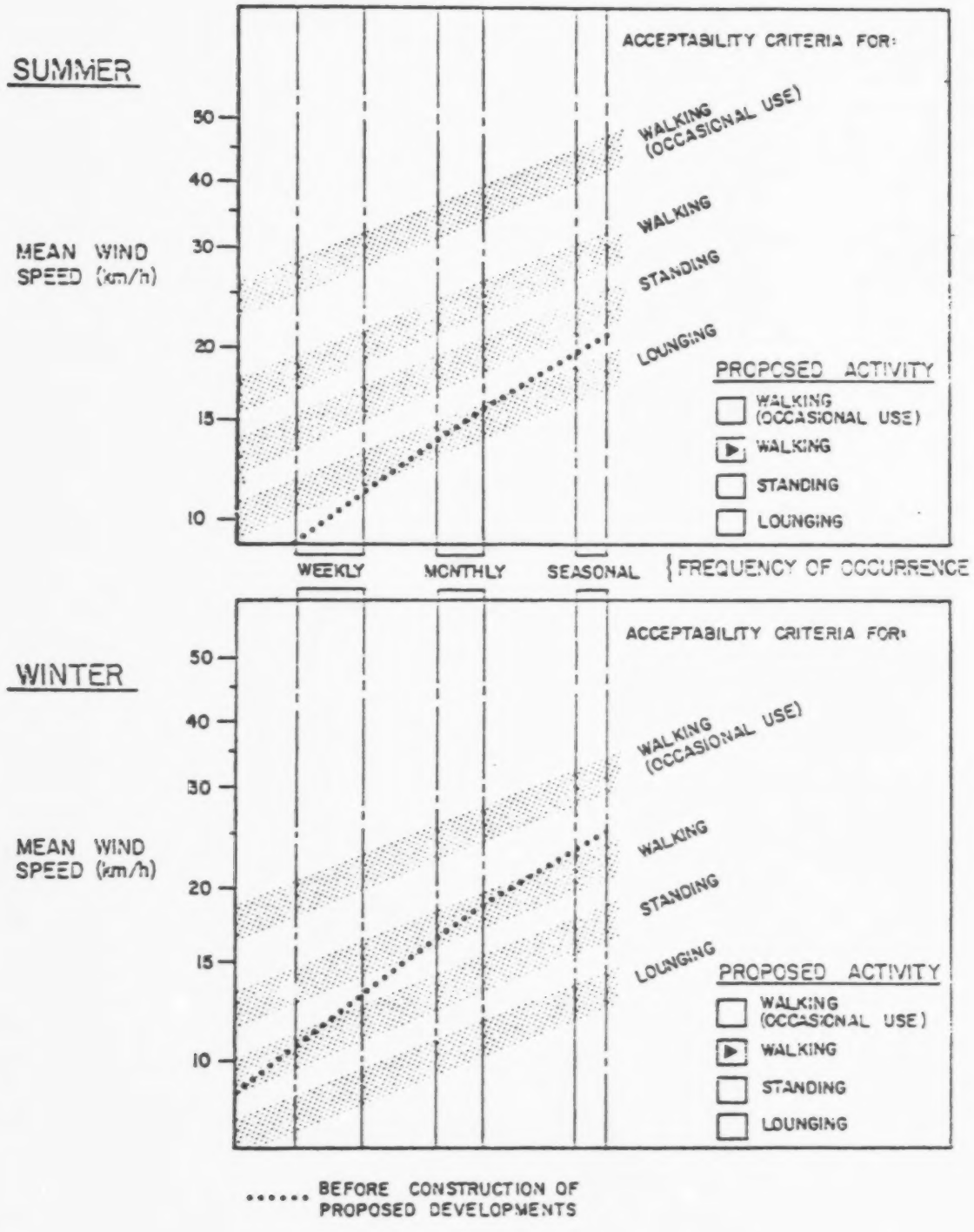
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (69)



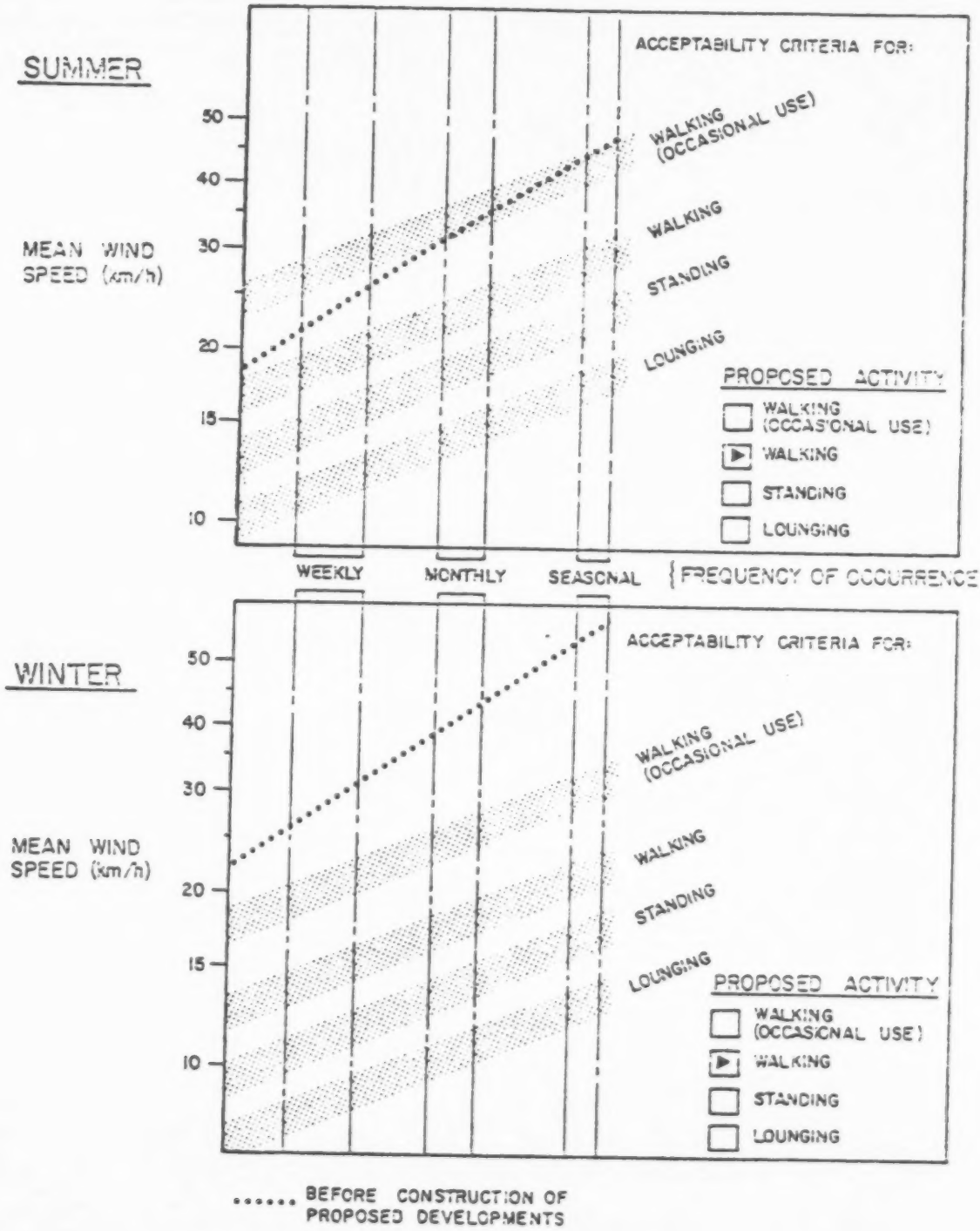
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (70)



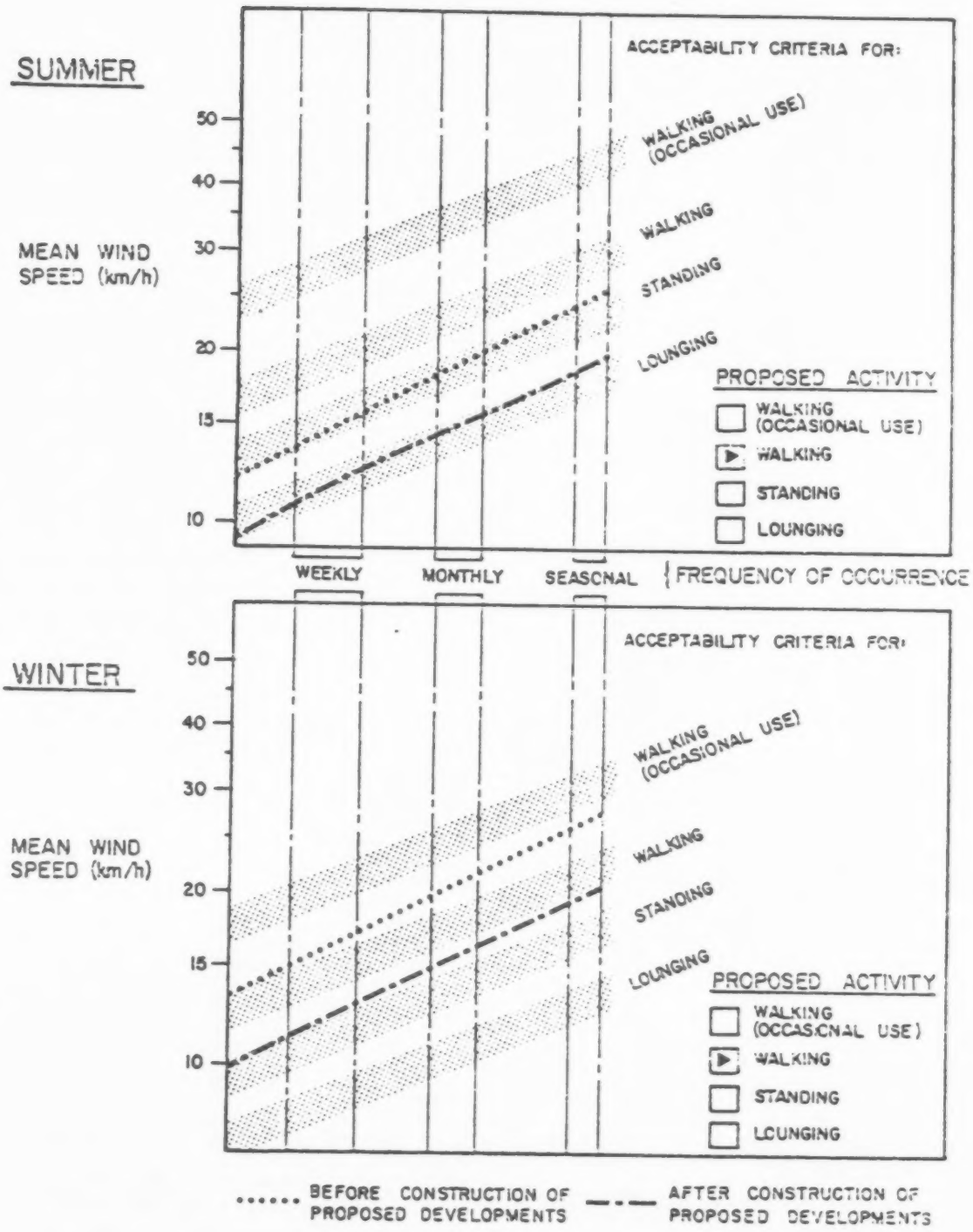
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (71)



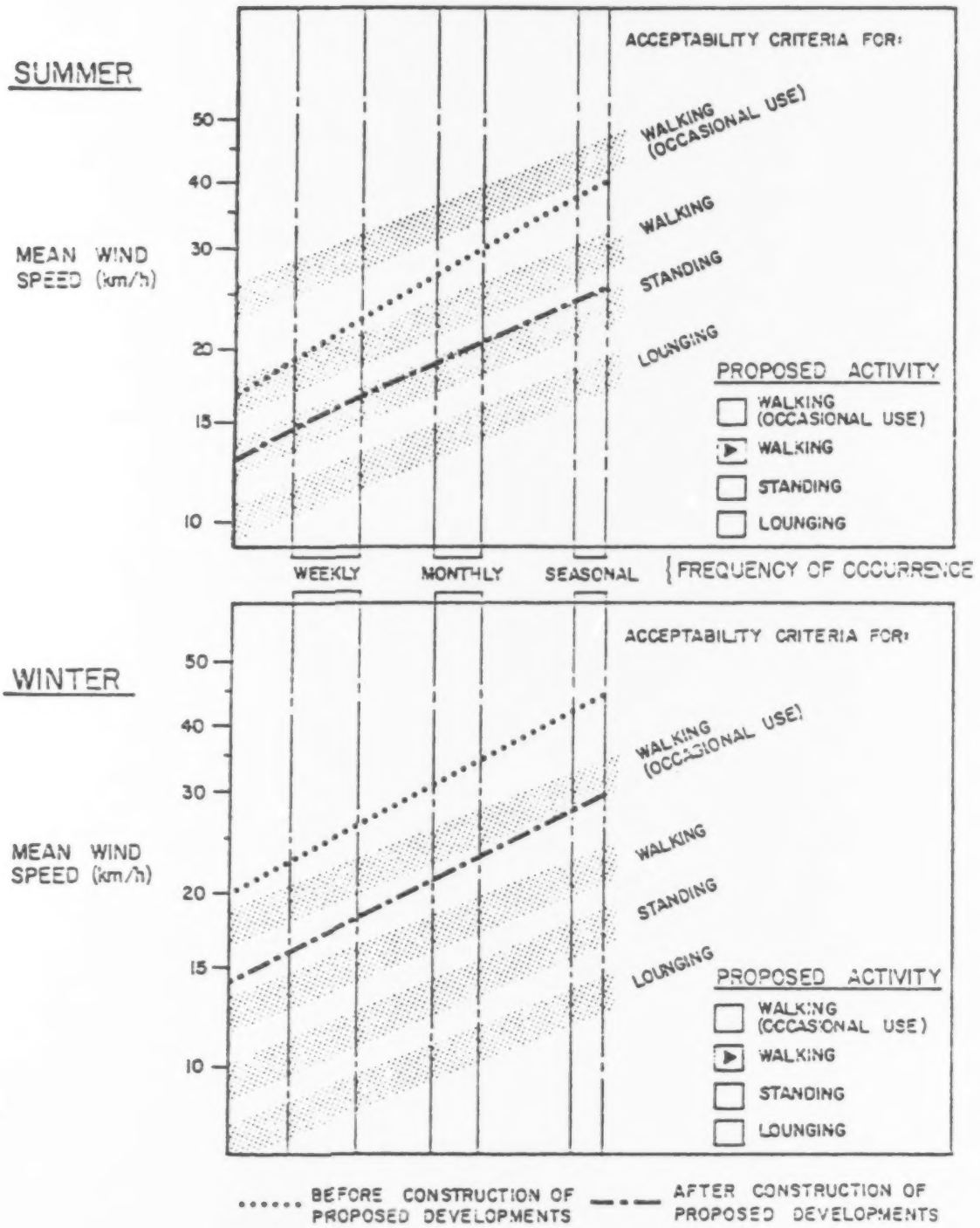
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (72)



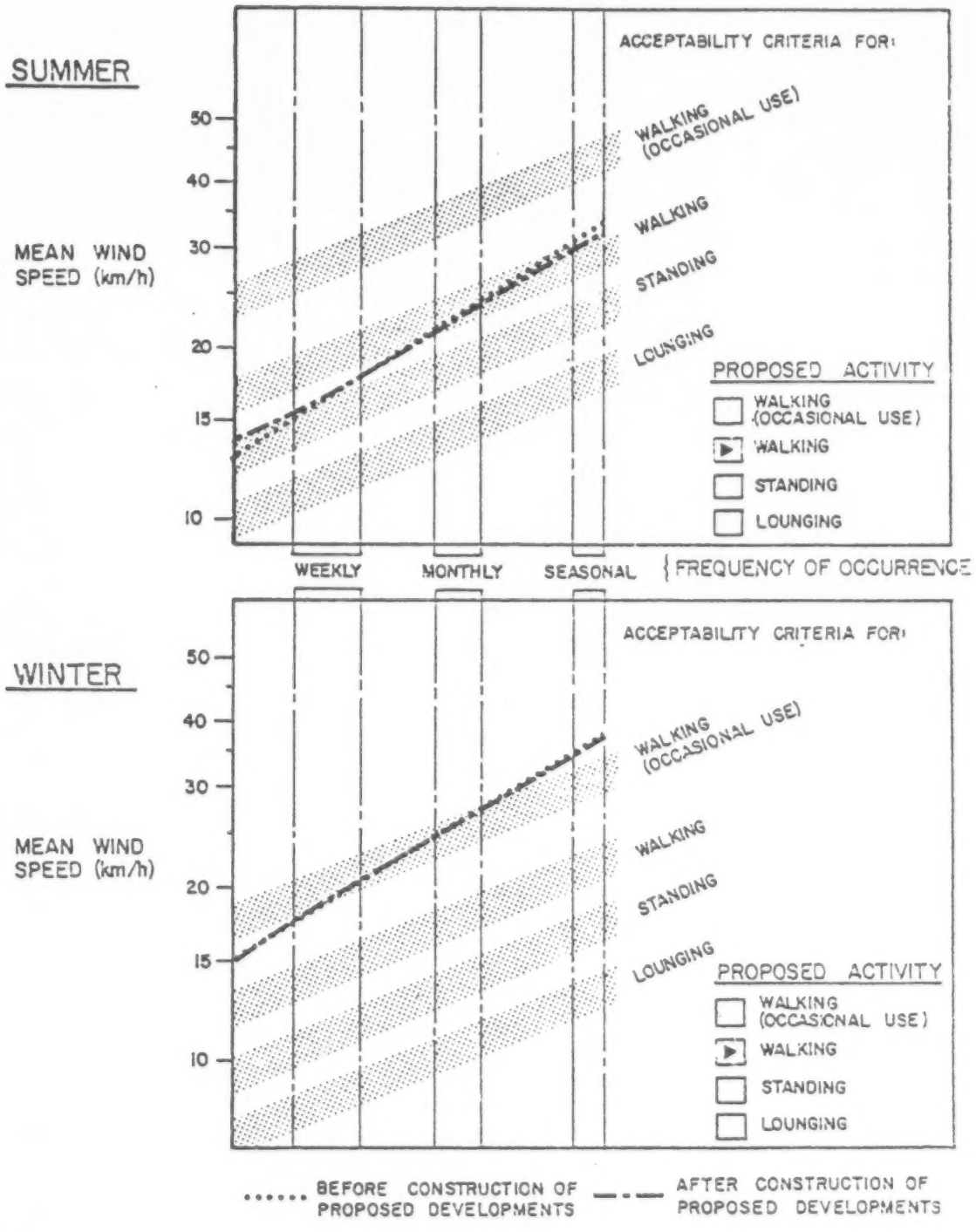
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (73)



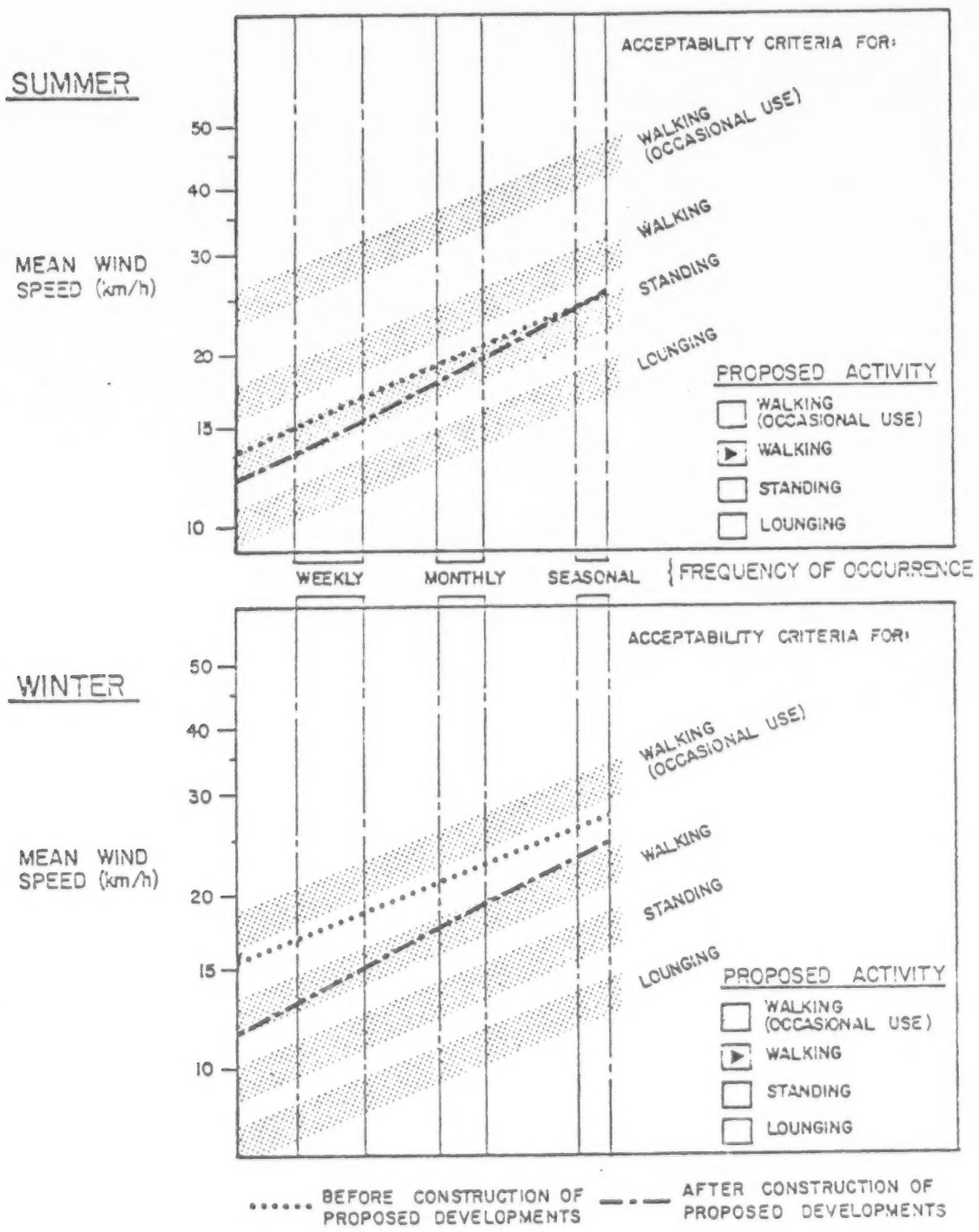
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (74)



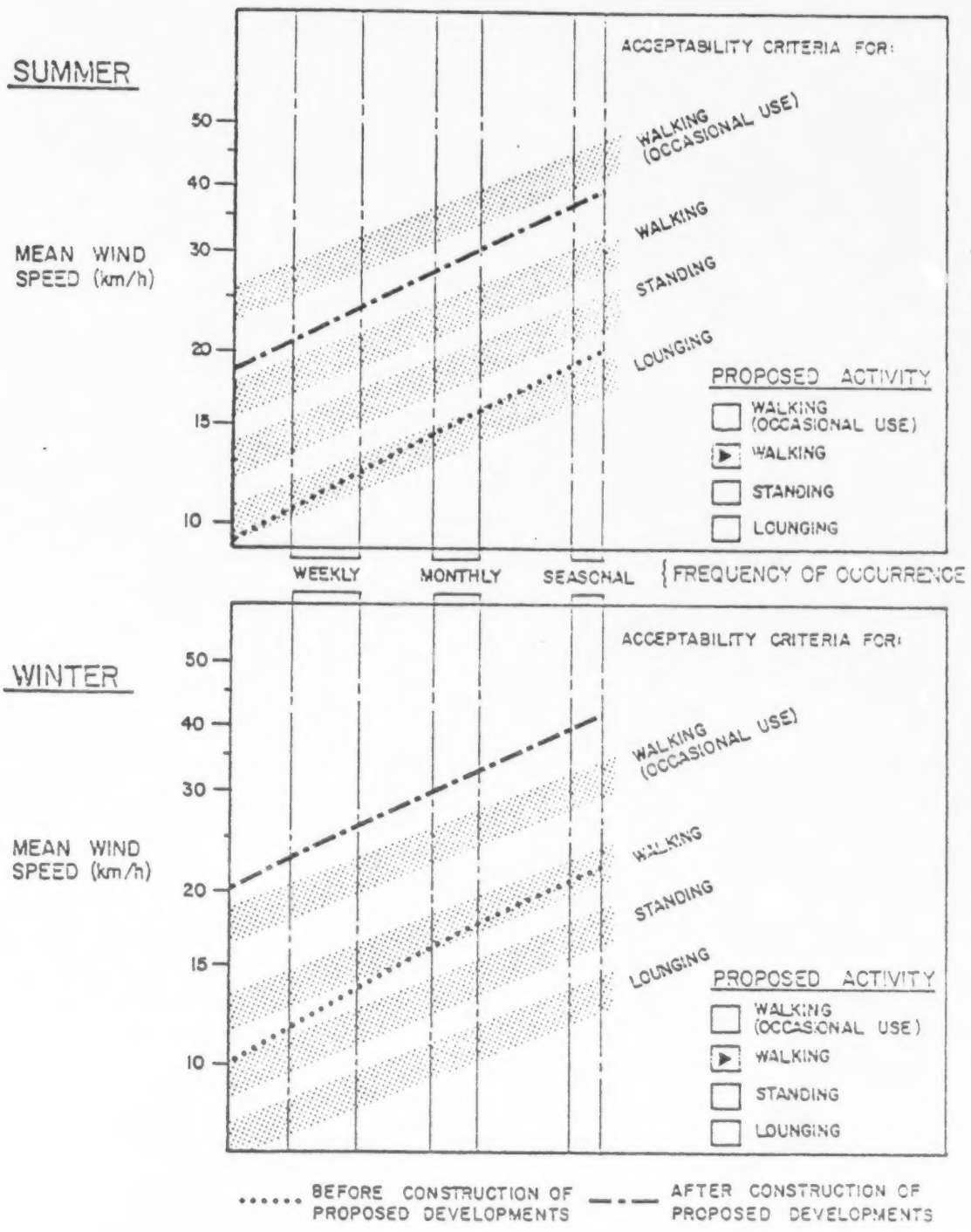
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (75)



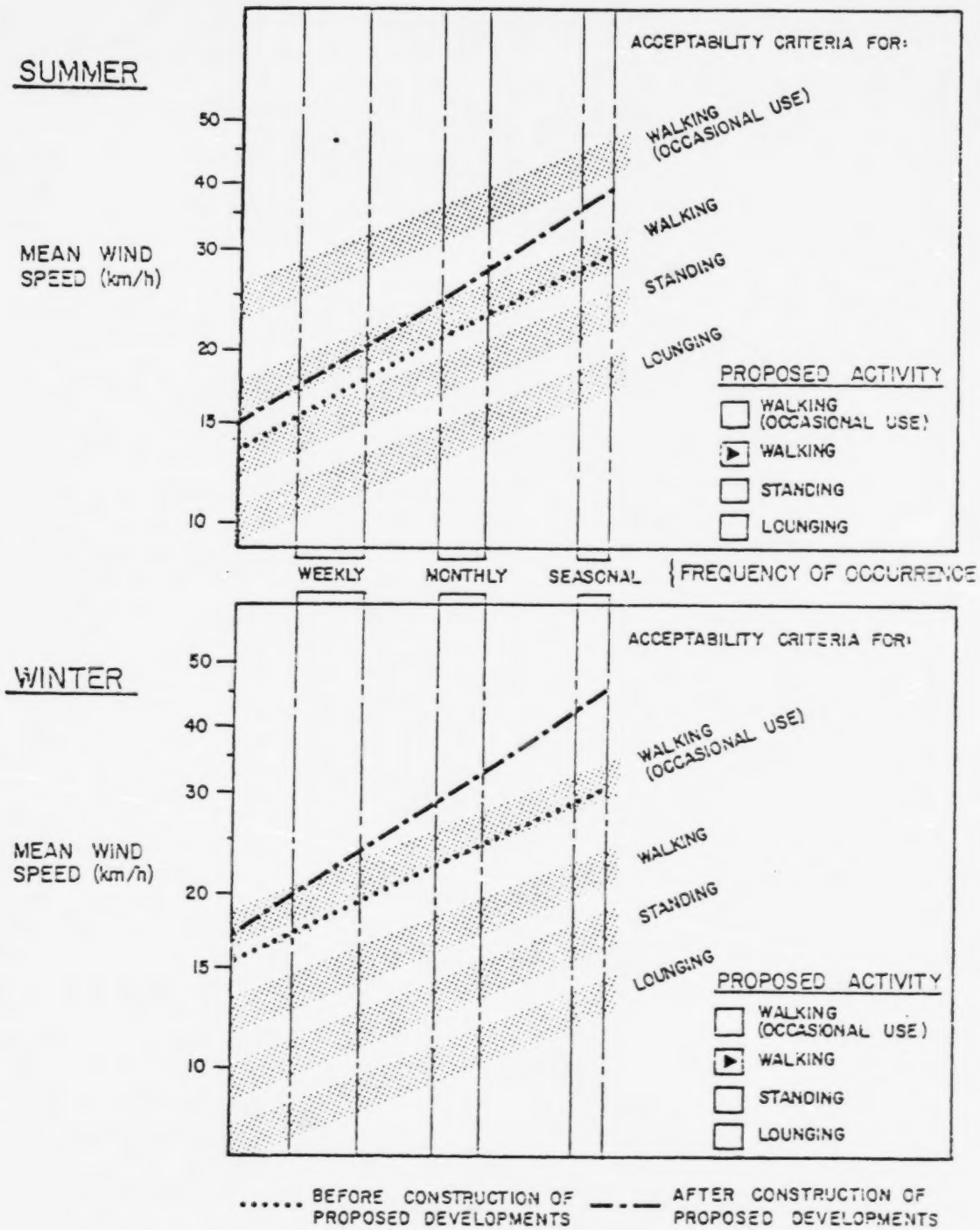
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (76)



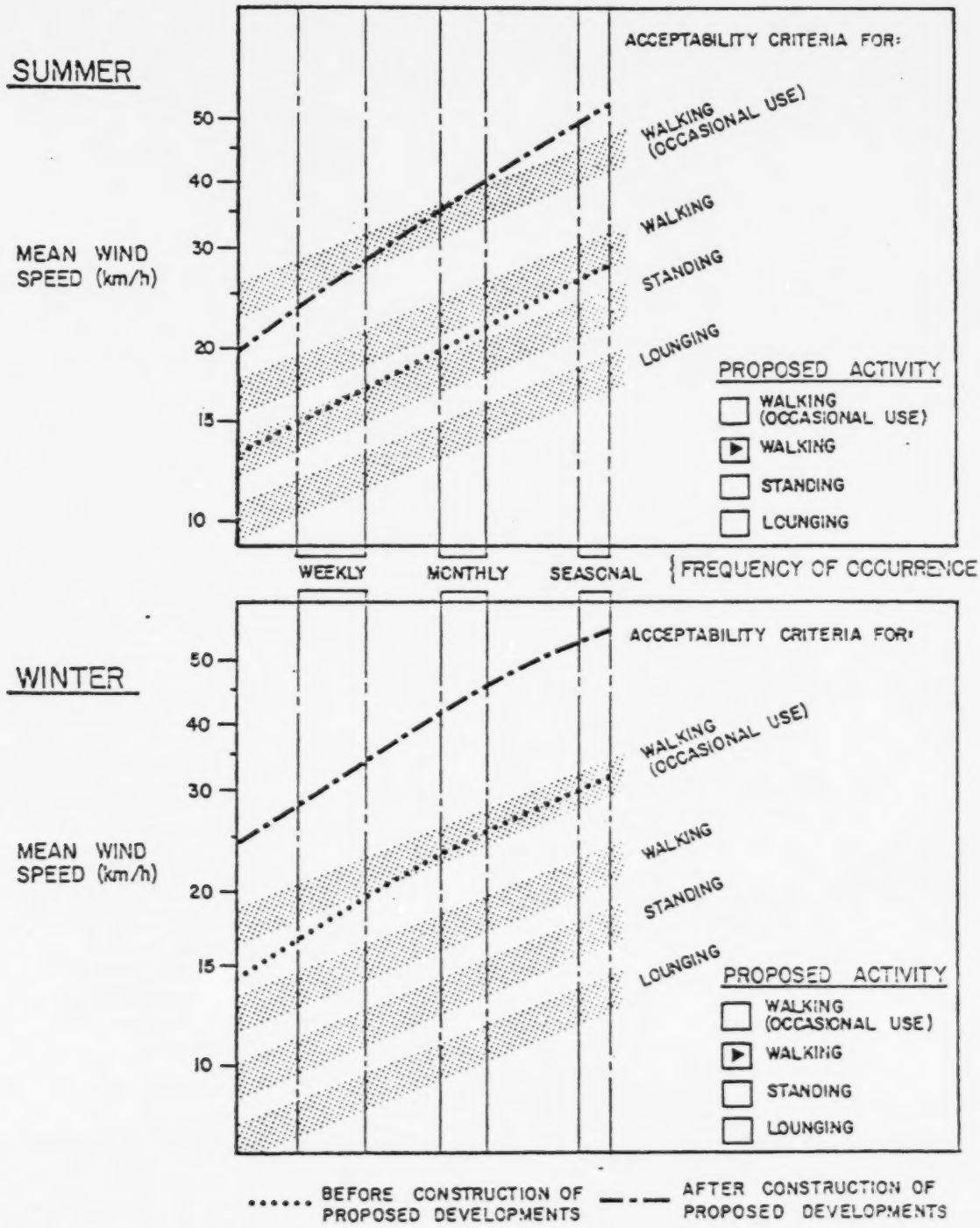
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (77)



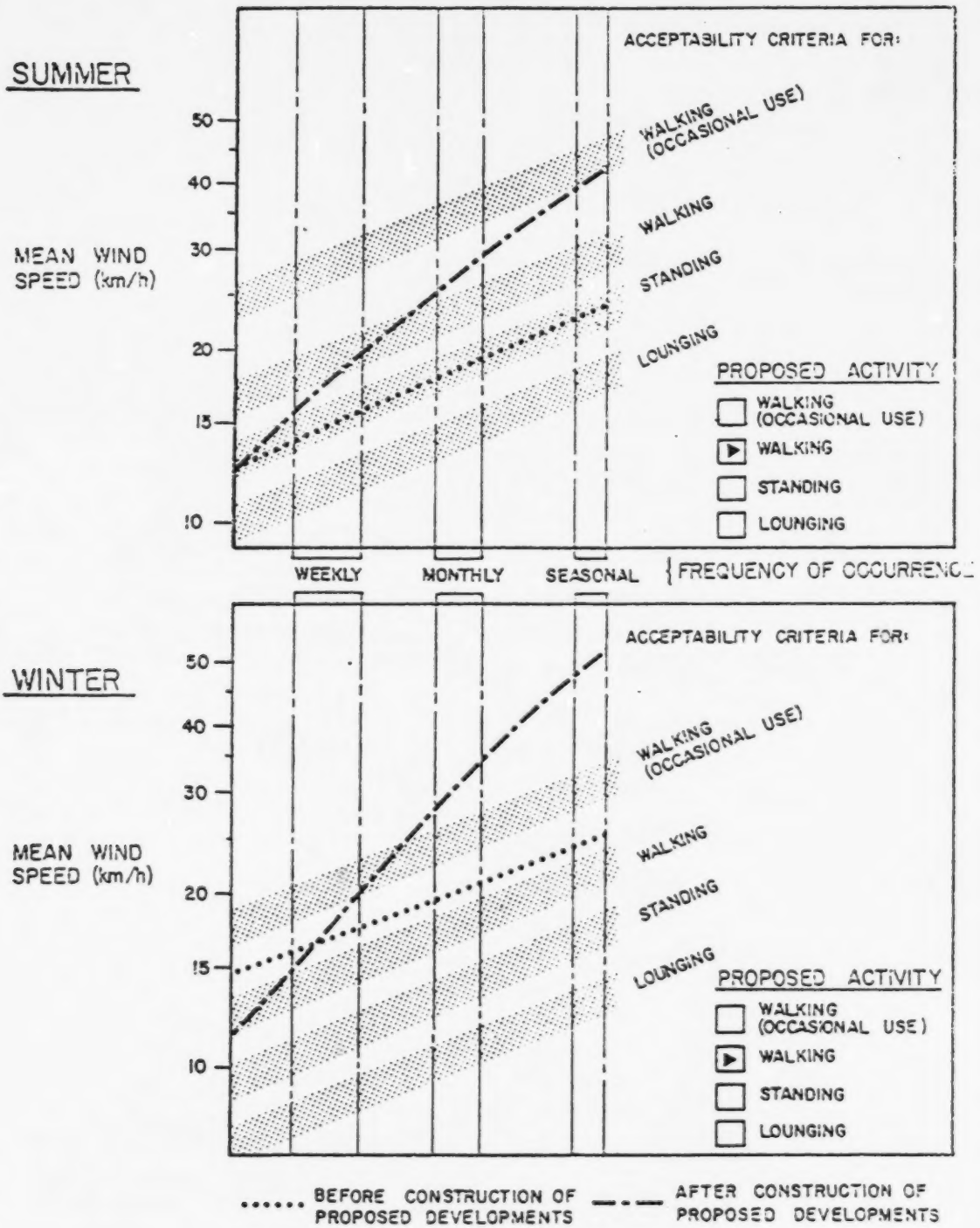
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (78)



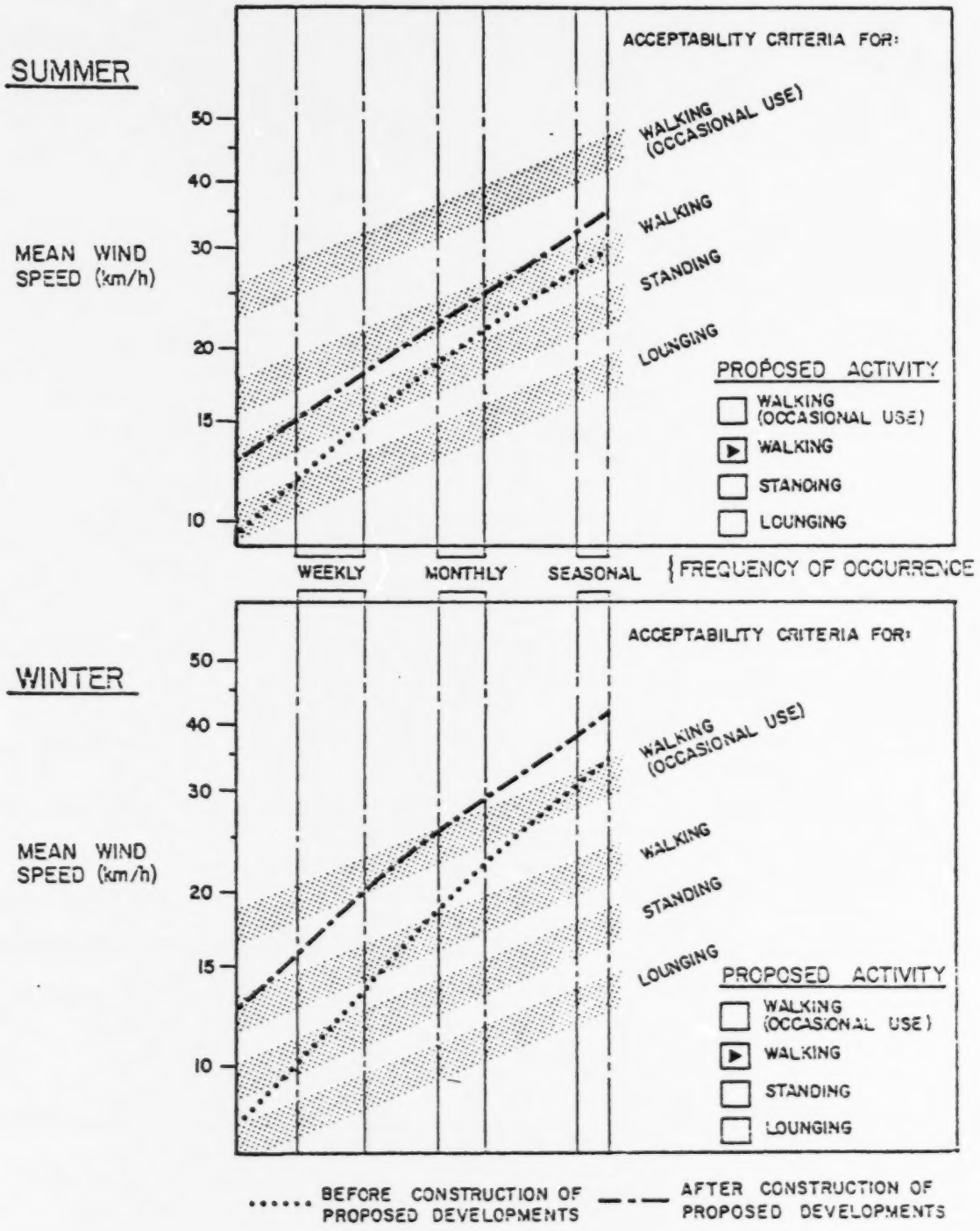
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (79)



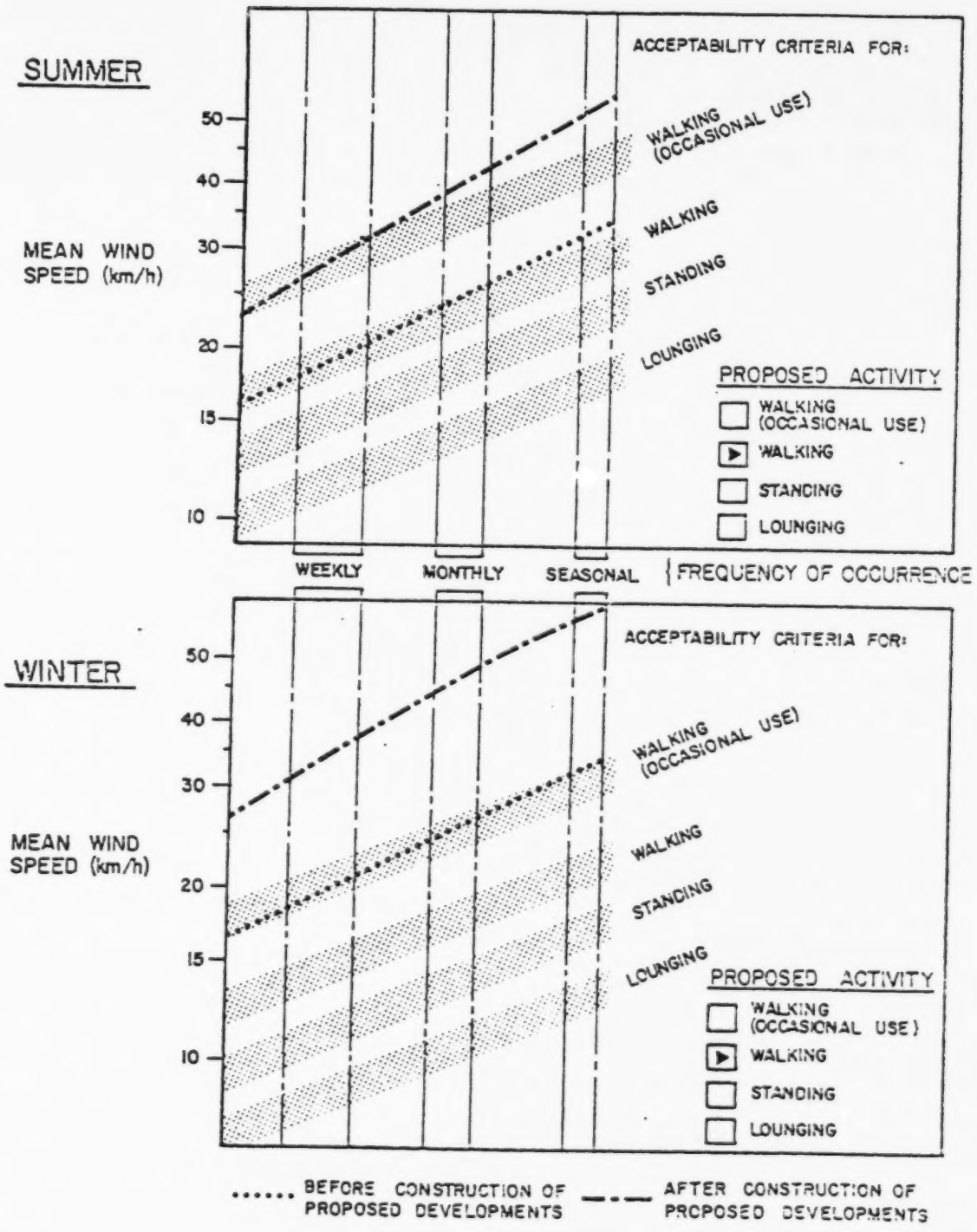
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (80)



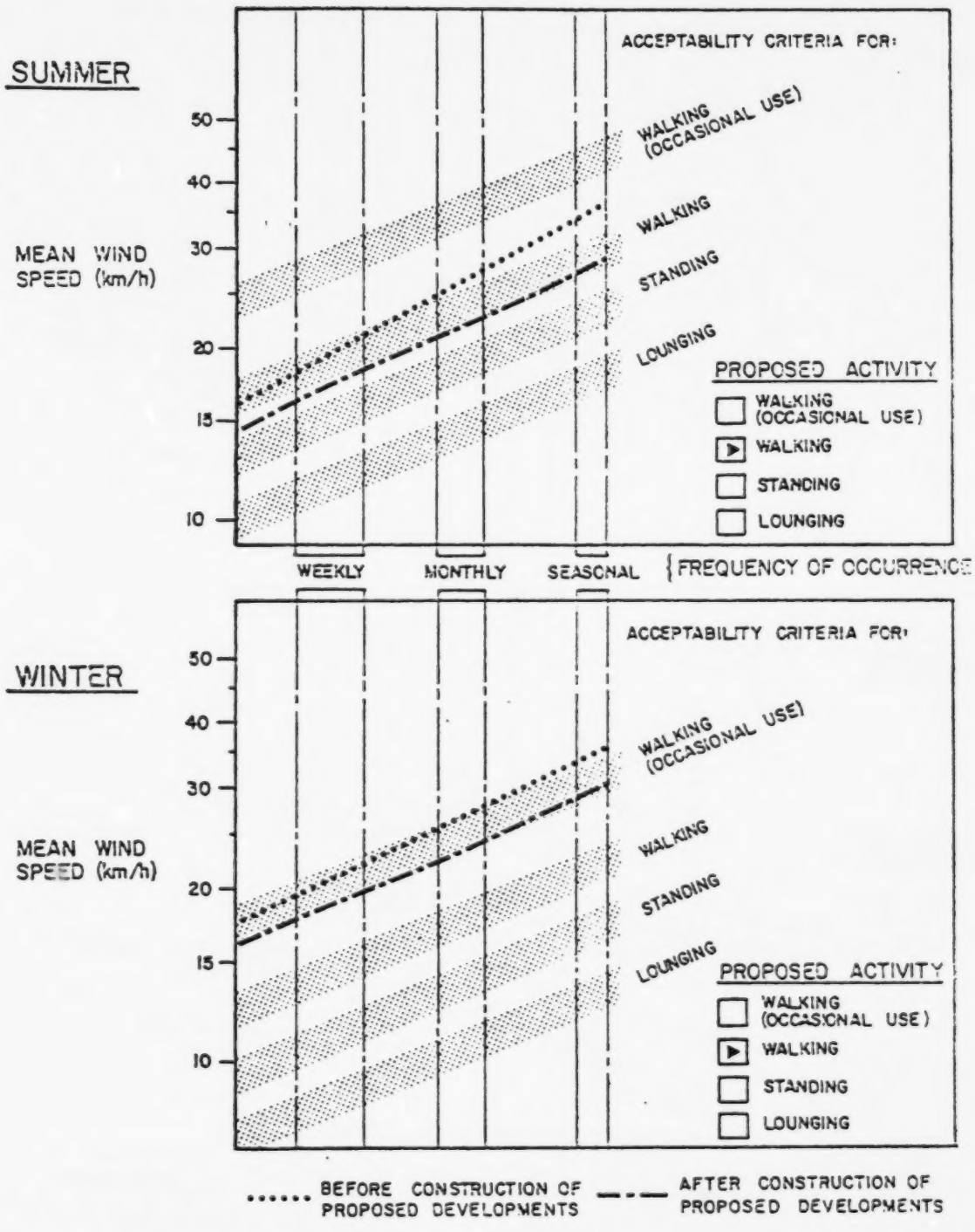
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (81)



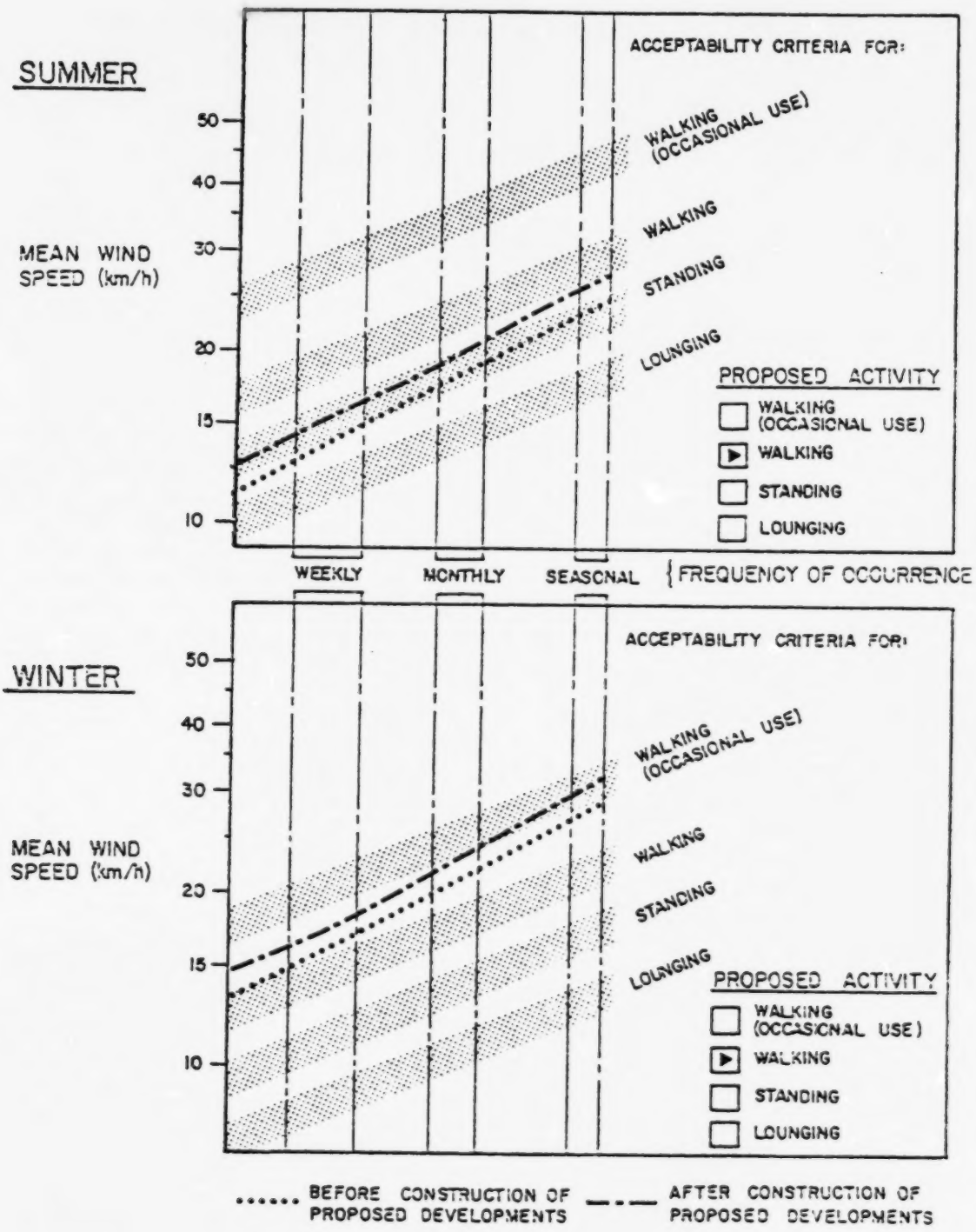
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (82)



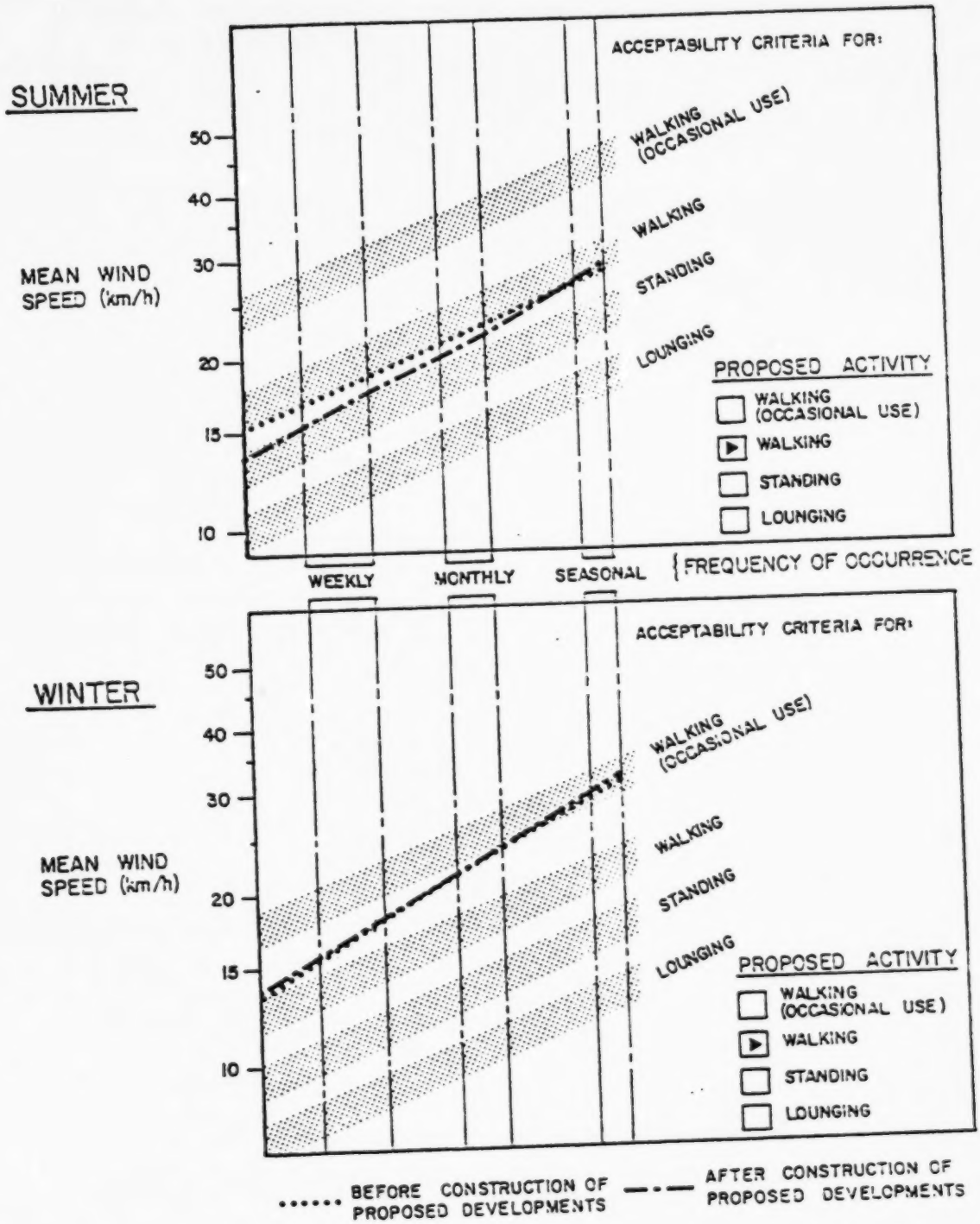
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (83)



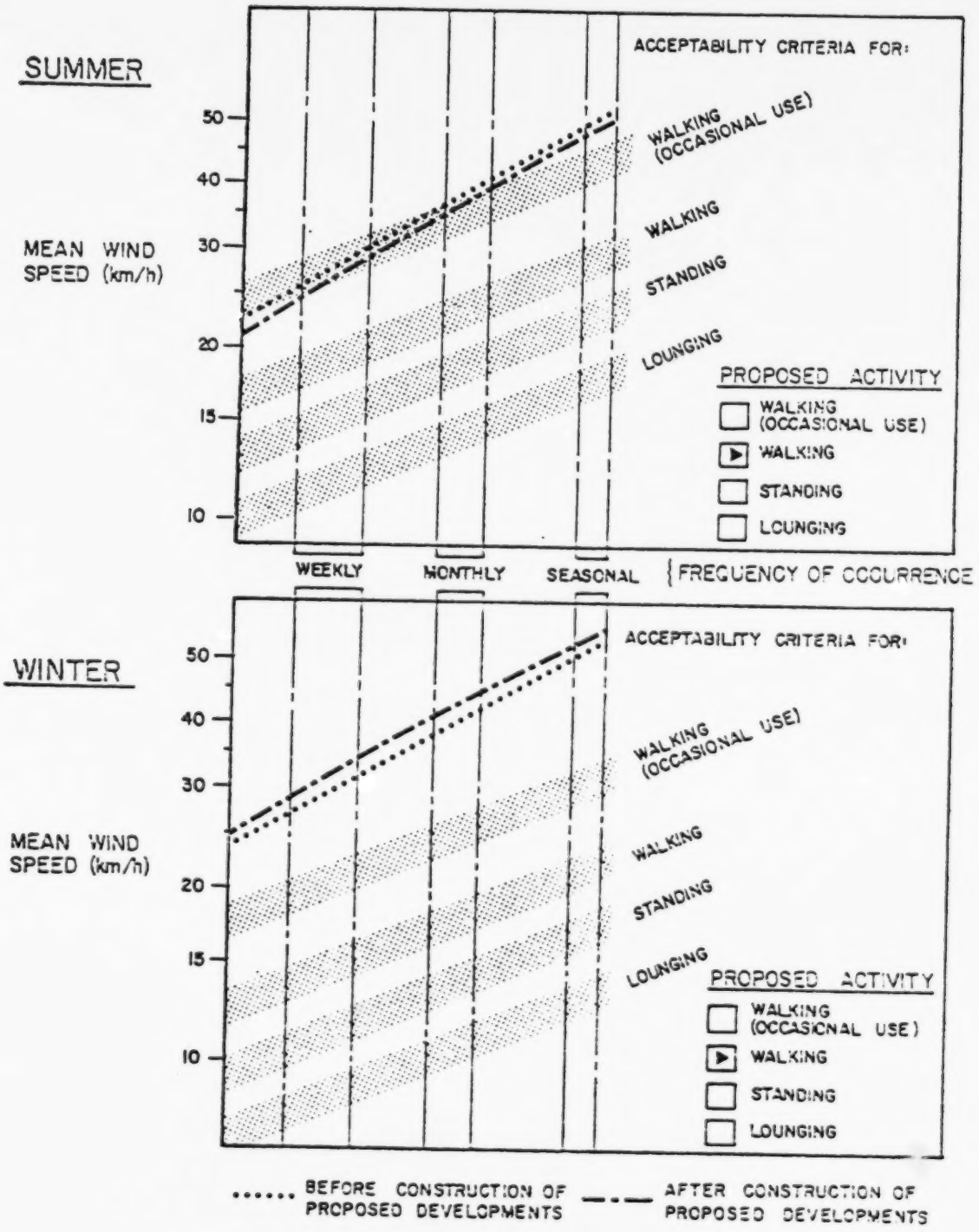
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (84)



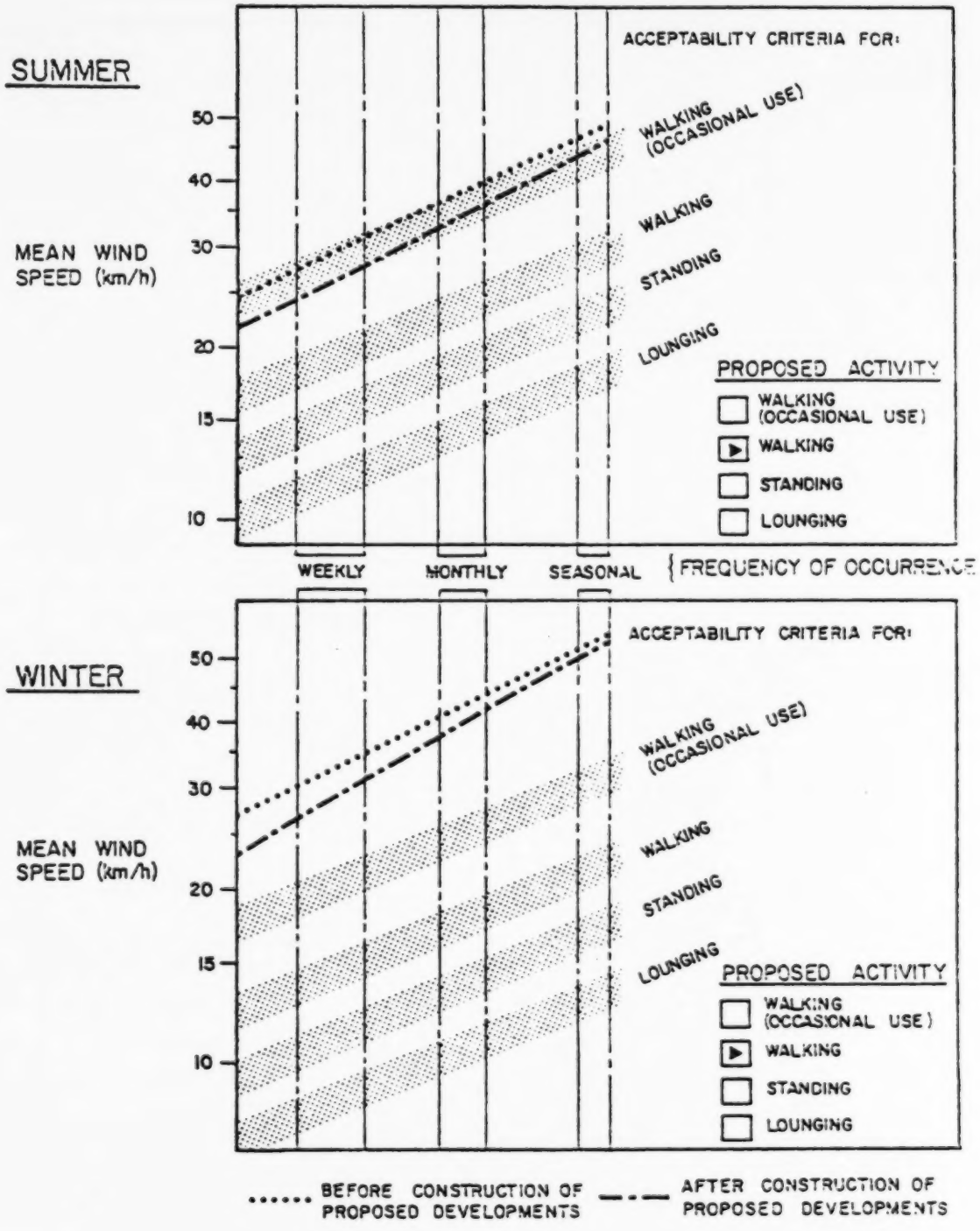
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (95)



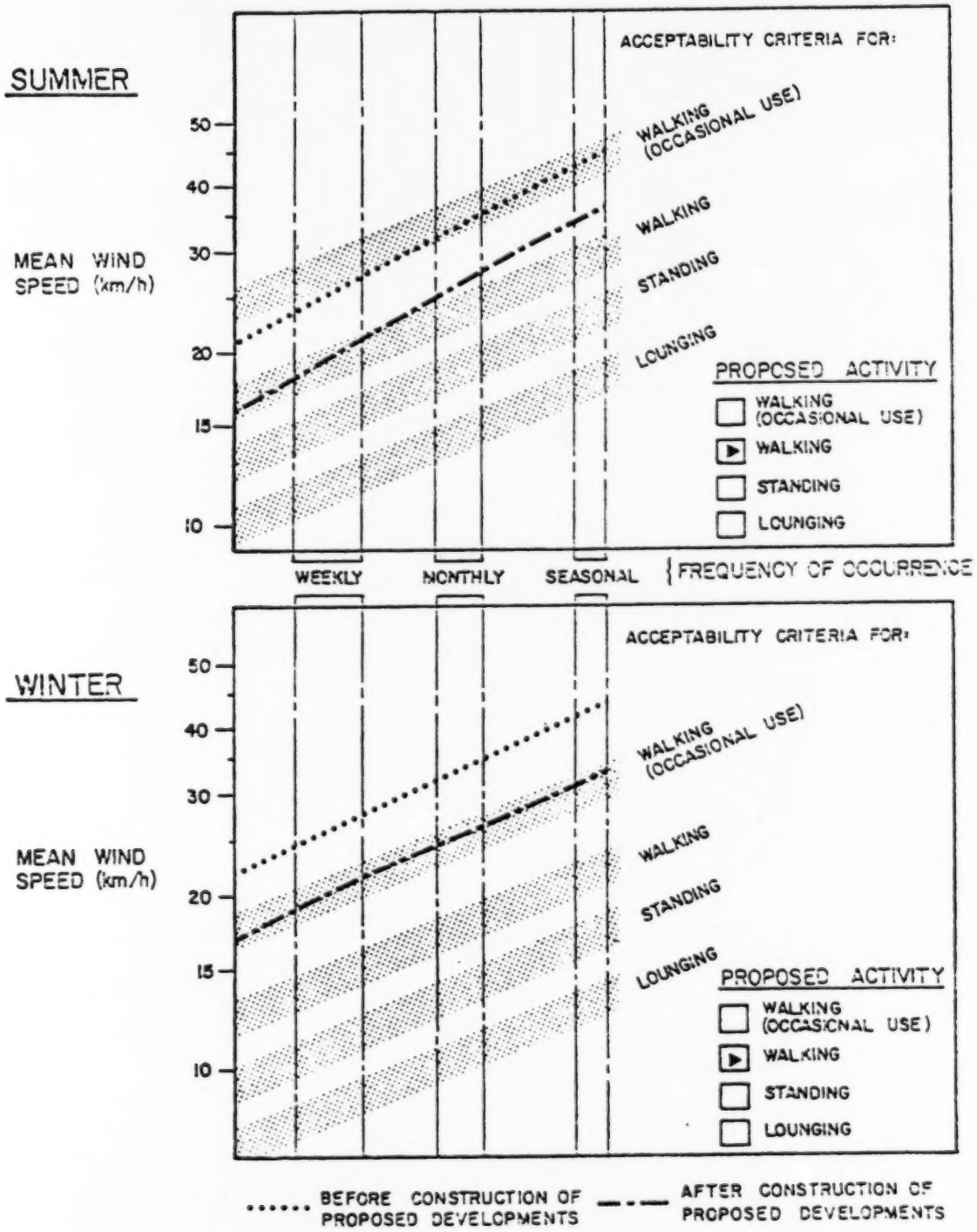
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (86)



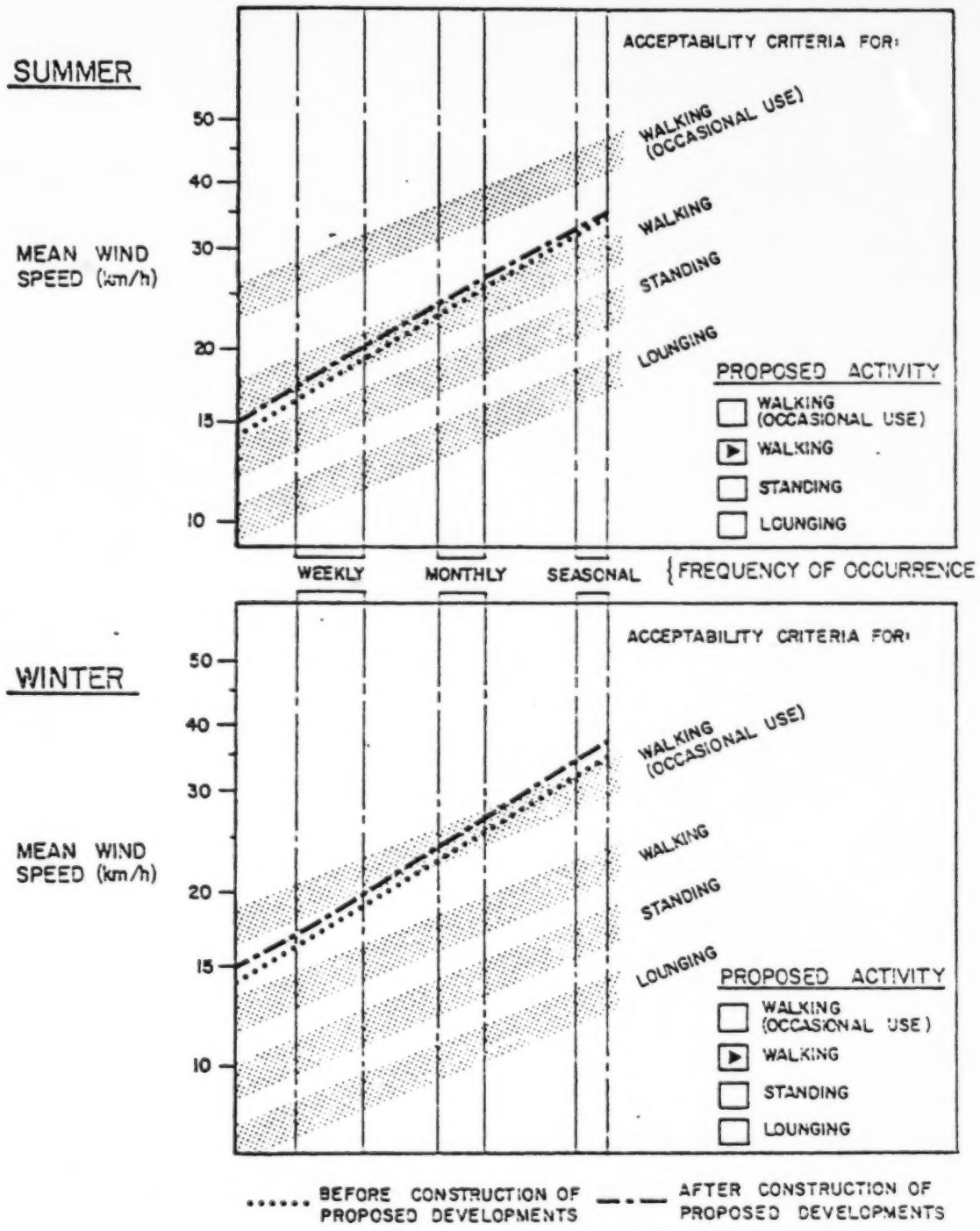
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (87)



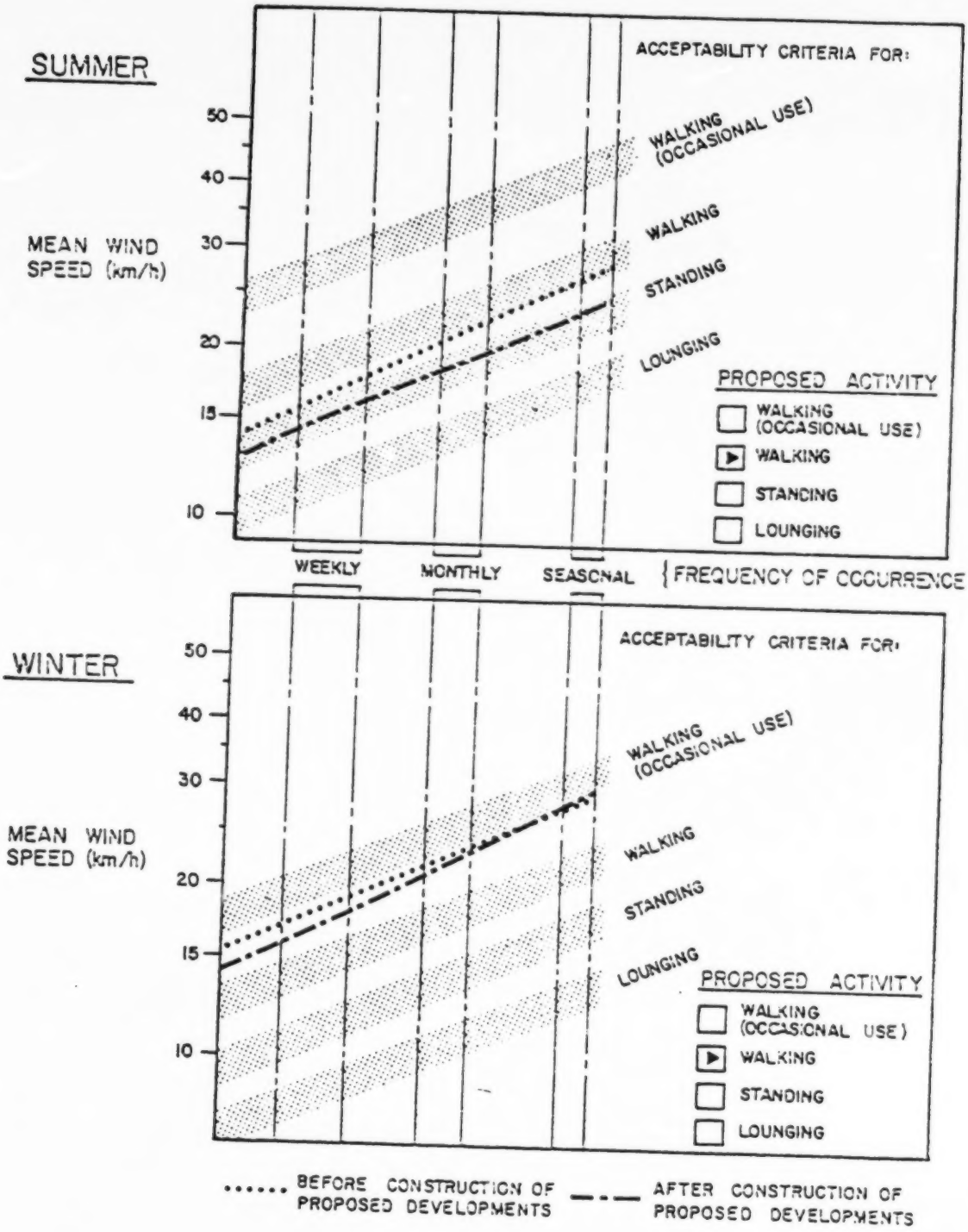
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (88)



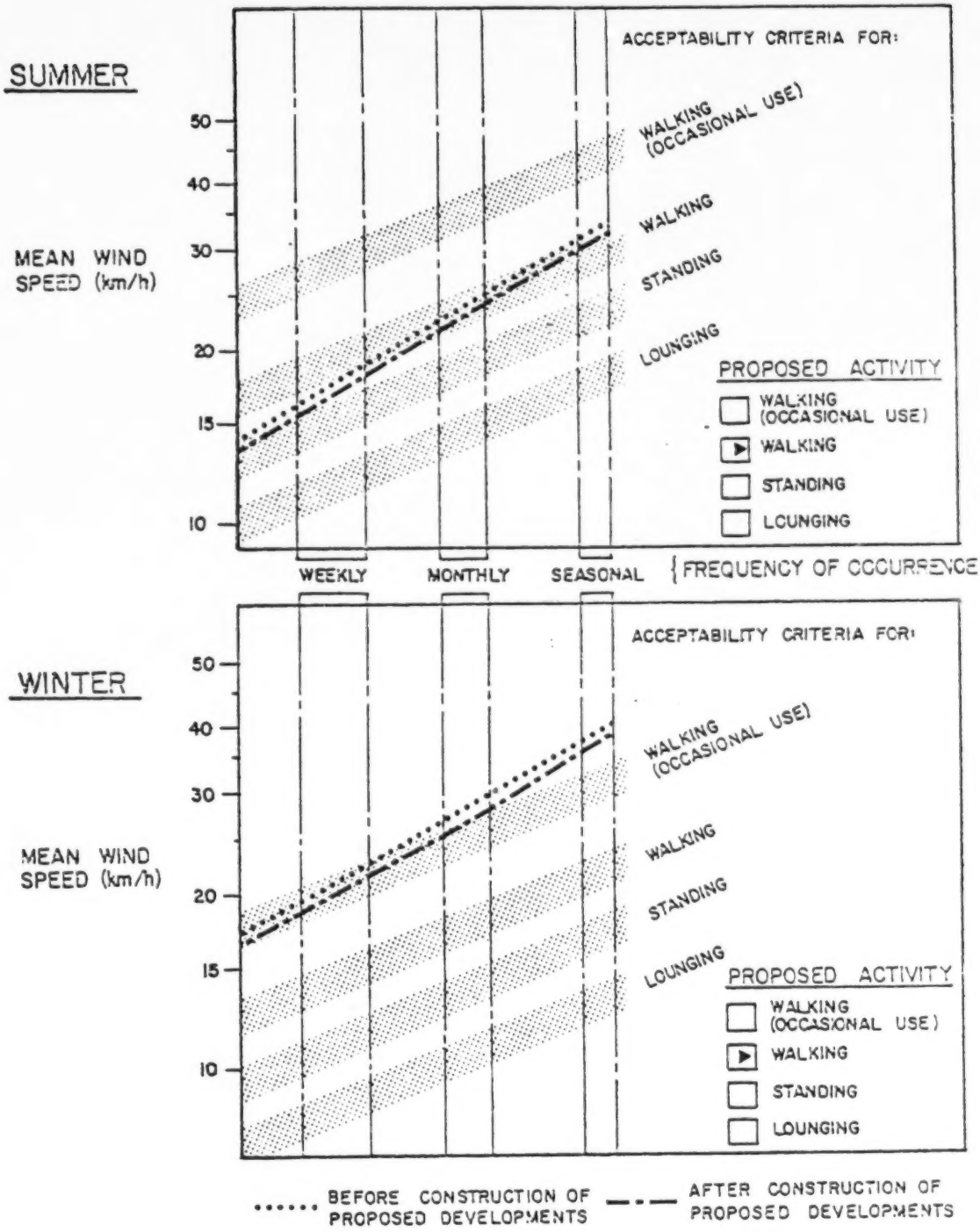
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (89)



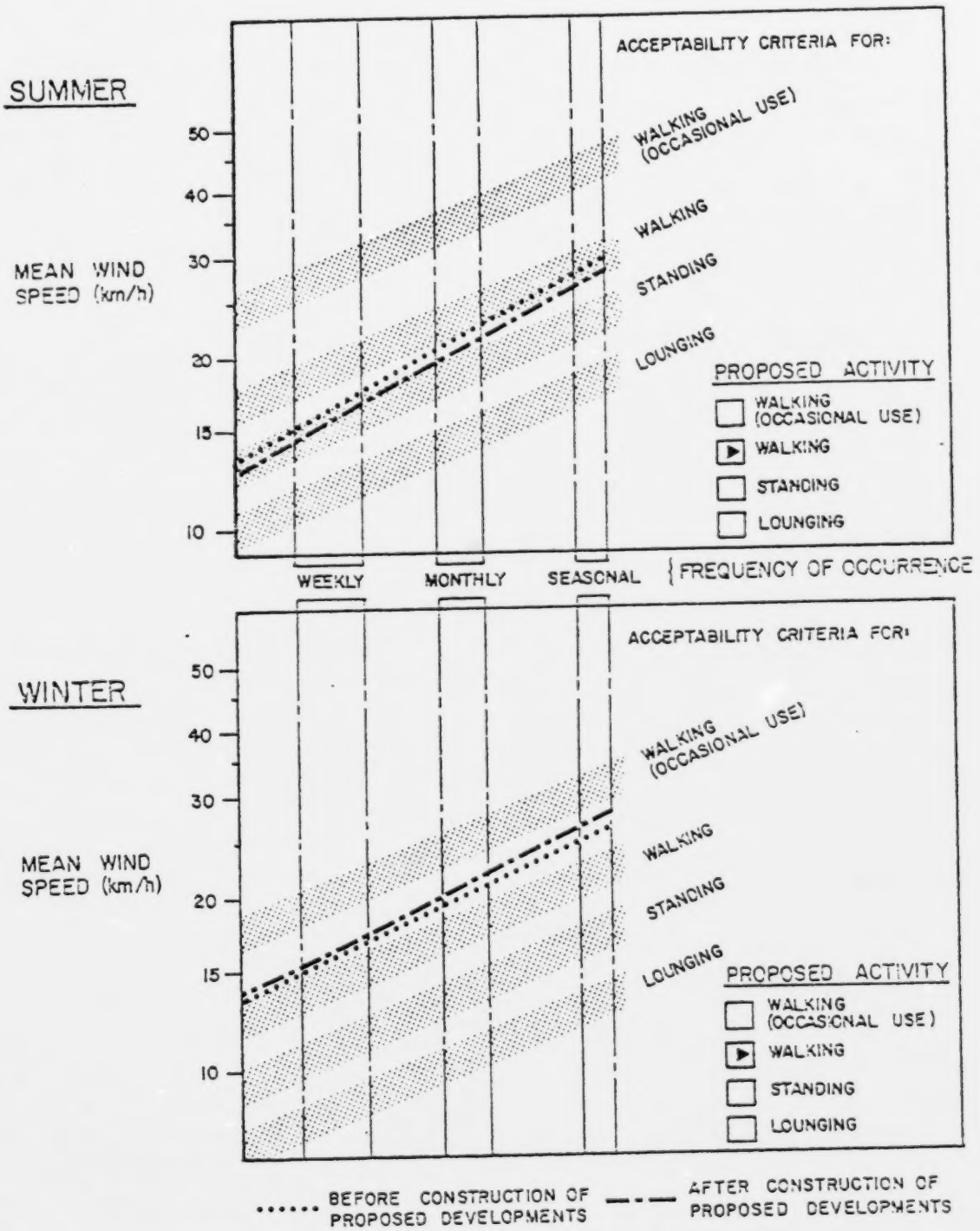
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (90)



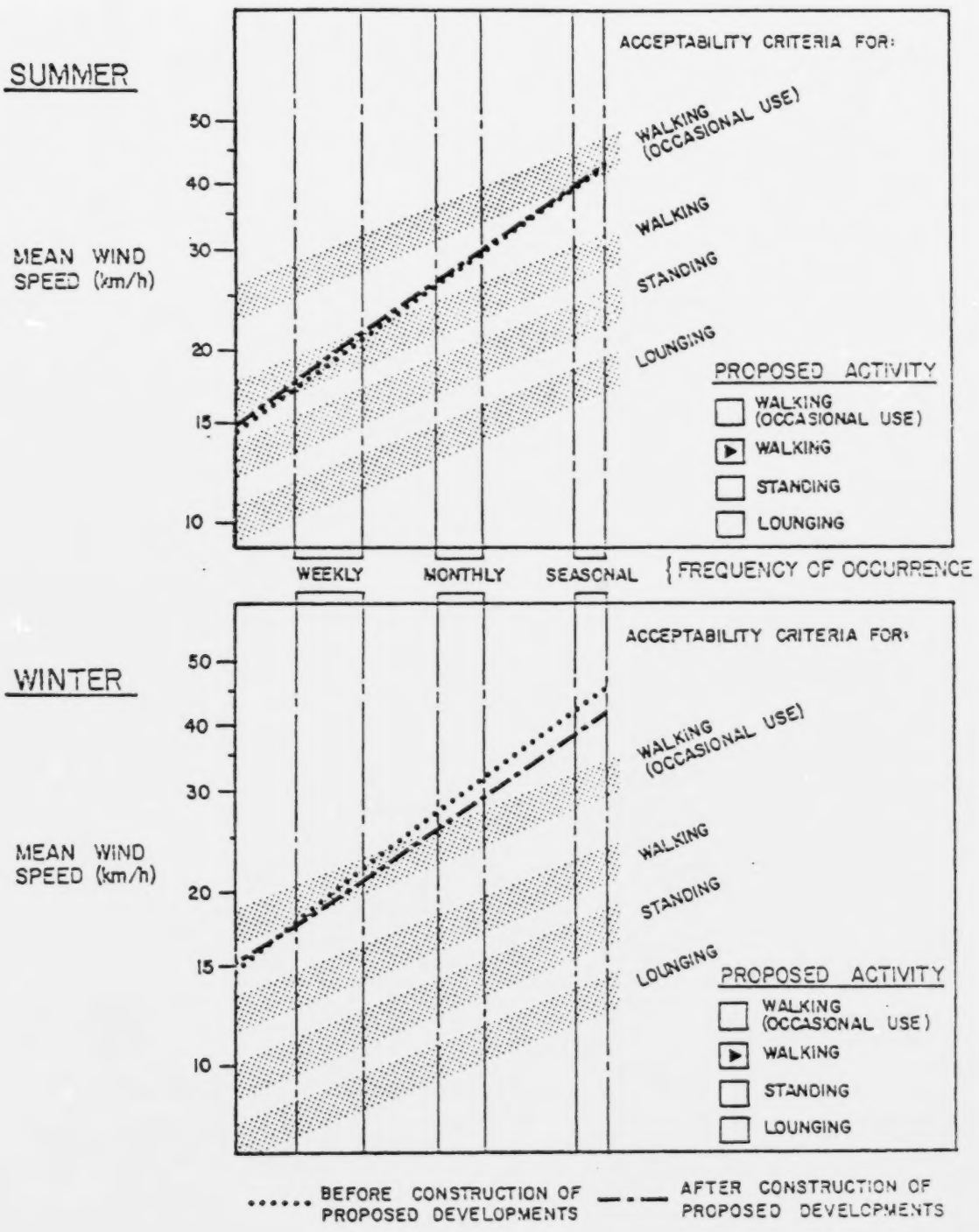
NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (91)



NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

MEAN WIND SPEED AND RELATIVE COMFORT LEVEL AT LOCATION (92)



NOTE: THE MEAN WIND SPEEDS SHOWN MAY BE DOUBLED DUE TO GUSTS.

APPENDIX B

Principles of Wind Engineering

APPENDIX B

PRINCIPLES OF WIND ENGINEERING

Morrison, Hershfield, Theakston and Rowan, Limited was retained by the City of Regina to complete a pedestrian level wind study on the downtown area of Regina and to offer advice on the preparation of wind control requirements for the future downtown development of Regina.

Pedestrian level wind conditions in many downtown areas are becoming increasingly problematic, principally due to the addition of high rise structures in the downtown core. It can be demonstrated using model simulation and flow visualization techniques that high rise buildings deflect winds from the upper levels of tall buildings to the pedestrian level. This additional flow causes increases in the pedestrian level wind speeds of two or even three times the wind speed experienced in areas unaffected by high rise buildings. On a typical day when wind speeds are 15 km/h in a suburban area around a city, a pedestrian within the downtown area will therefore be subjected to uncomfortable wind speeds in excess of 30 km/h. Every major North American city has areas which the residents of the city know as excessively windy areas.

Pedestrians in the City of Regina are well aware of the uncomfortable, and sometimes dangerous, wind conditions which presently exist at the City Hall and the S.G.I. Building. These conditions did not exist before construction of the high rise buildings in these areas.

Increasing the number of high rise developments in the downtown Regina area will result in an increase in the number and severity of wind problems if proposed developments are not assessed for their effects on the pedestrian level microclimate.

It is possible to design high rise buildings which will minimize the formation of adverse pedestrian level wind conditions. Scale model wind simulation tests can assist in this process. Such tests, conducted on the design of a proposed building, can assist architects in producing the optimum shape of a building to satisfy the requirements of good wind engineering practice while fulfilling the architectural constraints on the building.

The consideration of the wind environment around a project is advantageous to both the surrounding area and to the project itself since the commercial viability of ground level

retail areas can be jeopardized or pedestrian malls and downtown parks can be made too windy for frequent pedestrian usage.

General guidelines describing the wind flows around buildings have been included in this appendix in the accompanying figures. It is possible to use these guidelines, in conjunction with the meteorological data for Regina, to develop planning guidelines for desired building shapes in downtown Regina. As can be seen from the wind rose shown in Figure 2, the wind directions which require the most consideration are in decreasing order of importance: southeast, northwest, west-northwest, west, east-southeast, north-northwest and south-southeast.

When applied to Regina, the general guidelines shown in the enclosed figures provide the following specific guidelines which will assist in providing a comfortable pedestrian level microclimate.

Building faces which are oriented towards the prevailing north, west and southeast directions should receive the following general treatment:

1) Building faces should rise vertically above pedestrian levels for only 2 or 3 storeys and should then be set back by approximately 10 metres.

2) Canopies above pedestrian areas should be used.

3) Arcades, 3 to 5 m deep and/or 2 storeys high, preferably with large columns for protection, should be used.

4) Boulevard trees, planted to allow the foliage of the mature tree to be as close to the face of the building as possible, should be used outside of the arcades.

5) Building faces which are stepped away from pedestrian areas at a rate of approximately the dimension of one storey for each vertical rise of one storey will be less problematic.

6) Towers with a curved or hexagonal plan form deflect less wind to the pedestrian level than towers with a square or rectangular plan form.

If two or more towers are proposed for the same development, and are to be constructed on the same site, the space between the towers should be in a northeast-southwest direction or east-west direction.

Open passageways through tall buildings are not recommended, however if constructed they should not run in a direction aligned with prevailing winds. Passageways aligned in the north-south direction would be better than in the east-west direction.

In all major downtown developments, sufficient area should be provided around pedestrian areas, in order to allow room for landscaping that may be required to control locally adverse wind conditions.

If the City of Regina proposes to control future downtown growth with respect to wind, then any requirements drafted should state:

1) That all buildings, regardless of height, must be reviewed for wind impact on the downtown development. Within the downtown area, all proposed buildings should include at least a statement on the effect of the proposed building, as even 6 or 8 storey buildings can be critical.

2) That any statements on wind effects should be submitted by qualified wind engineers and, more important, the reasons for the statements should be substantiated. This should consist of at least a discussion of the wind flows within the area for the prevailing wind directions. Model simulation tests which can, if necessary, be demonstrated to a Development Officer, leave no room for opinion on the part of the professional involved.

3) That the optimum benefit from a wind study is obtained at the early massing stages of a project. Proof that wind has been one of the design considerations from the onset of the project is the ultimate method of enforcing wind control. This could be accomplished by requiring a brief report discussing why a particular arrangement of buildings or shape of a building had been selected from a pedestrian level wind point of view. A report such as this should be submitted as part of the first submission of a development.

4) That if the above report on the massing of the buildings suggests possible wind problems, a detailed study should be requested. The detailed study should clearly state how the design was altered to overcome the problems discussed in the massing study.

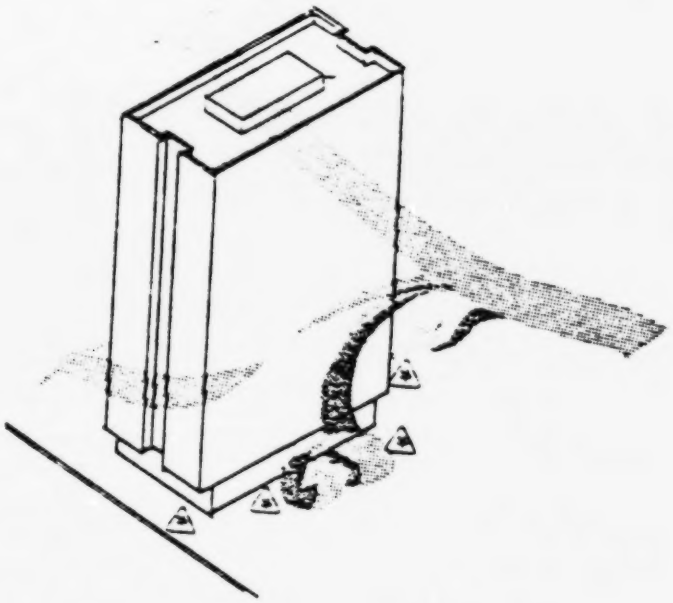
In conclusion, wind engineering can be a useful tool for minimizing the adverse pedestrian level wind conditions in the downtown city core of Regina. In order to ensure that adverse wind conditions are minimized, future developments should be required to consider wind engineering aspects of the design and to take remedial action to alleviate uncomfortable conditions before construction begins.

LOCALIZED MODIFICATION OF MICROCLIMATE BY VARIOUS BUILDING MASSES.

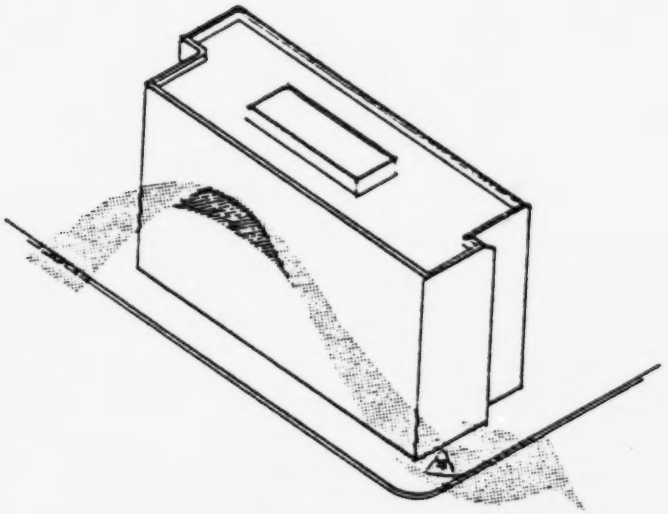
- In the following sketches, which show some of the known wind effects on buildings, ⛆ indicates an area which will be adversely affected by the wind direction shown. Conversely, a comfortable pedestrian area is indicated by ⊛

- The wind effects shown will alter, in some cases drastically, when surrounding buildings are added. The information should, therefore, only be used for conceptual planning. Detailed scale model studies are the only acceptable method of obtaining quantitative information on the pedestrian level wind speeds around buildings.

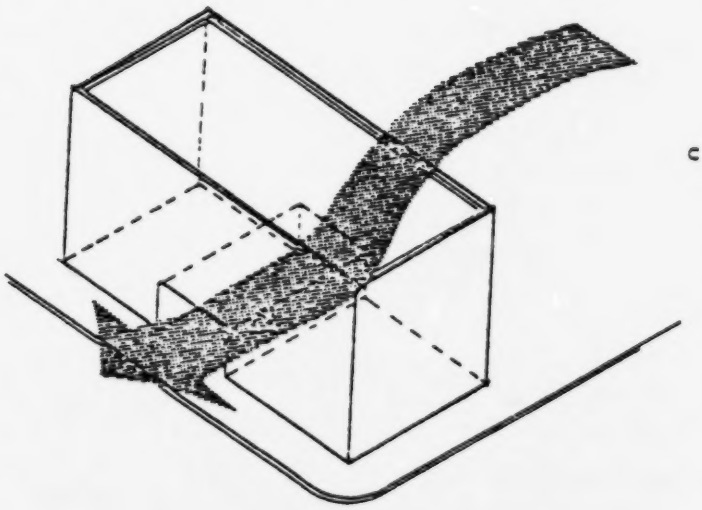
- Relative dimensions of building forms to create the shown wind flows can be inferred from the sketches. Exact dimensions will, of course, depend on the surrounding buildings.



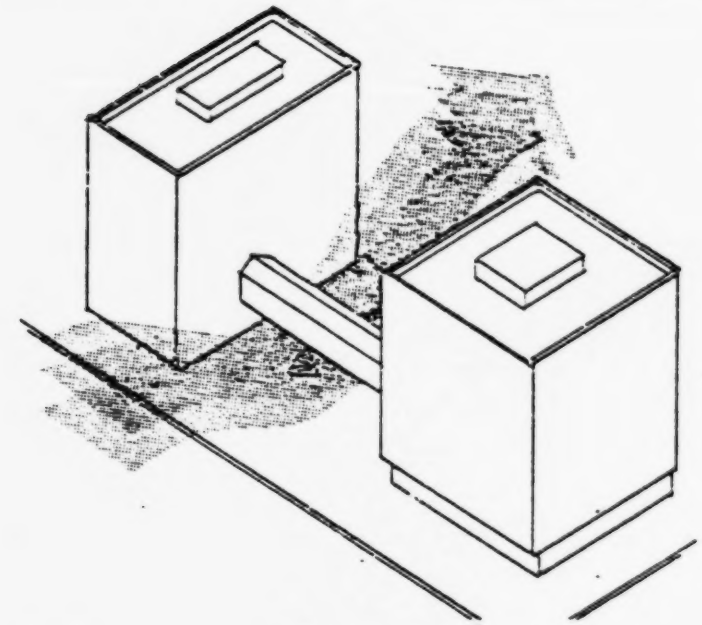
a) This effect is magnified as building height increases.



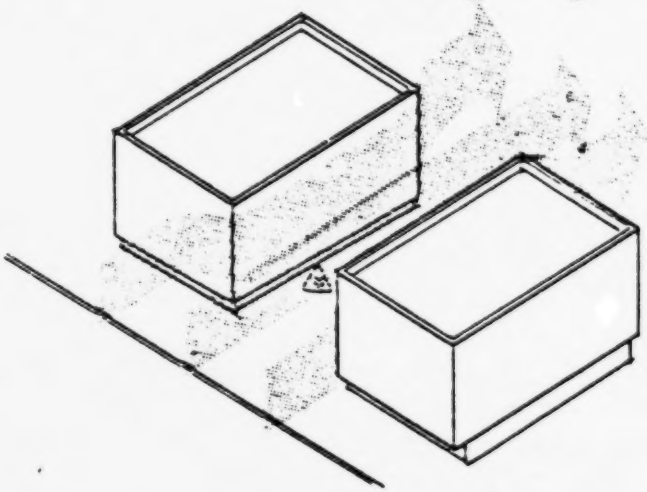
b) Wind flowing at an angle to a long (and tall) building will be concentrated at the downwind corner of the building. The longer the building the greater the increase in pedestrian level wind speed.



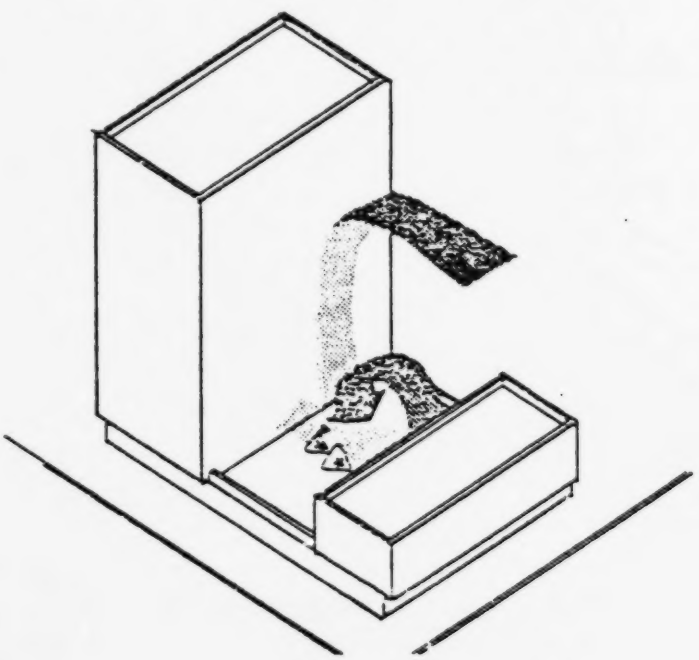
c) An open passageway through a tall building creates and uncomfortable condition in the passageway and reduces the sheltered condition behind the building.



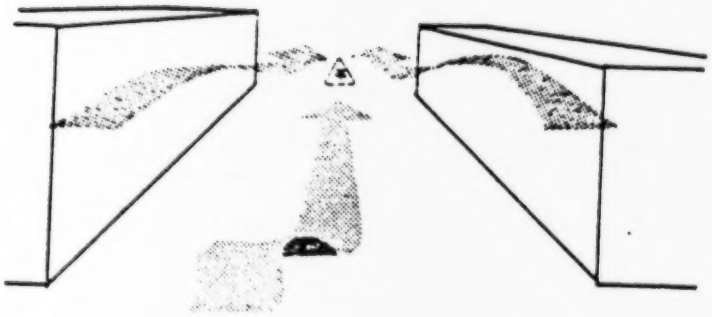
a) - 15 level walkways can further increase already accelerated wind flows.



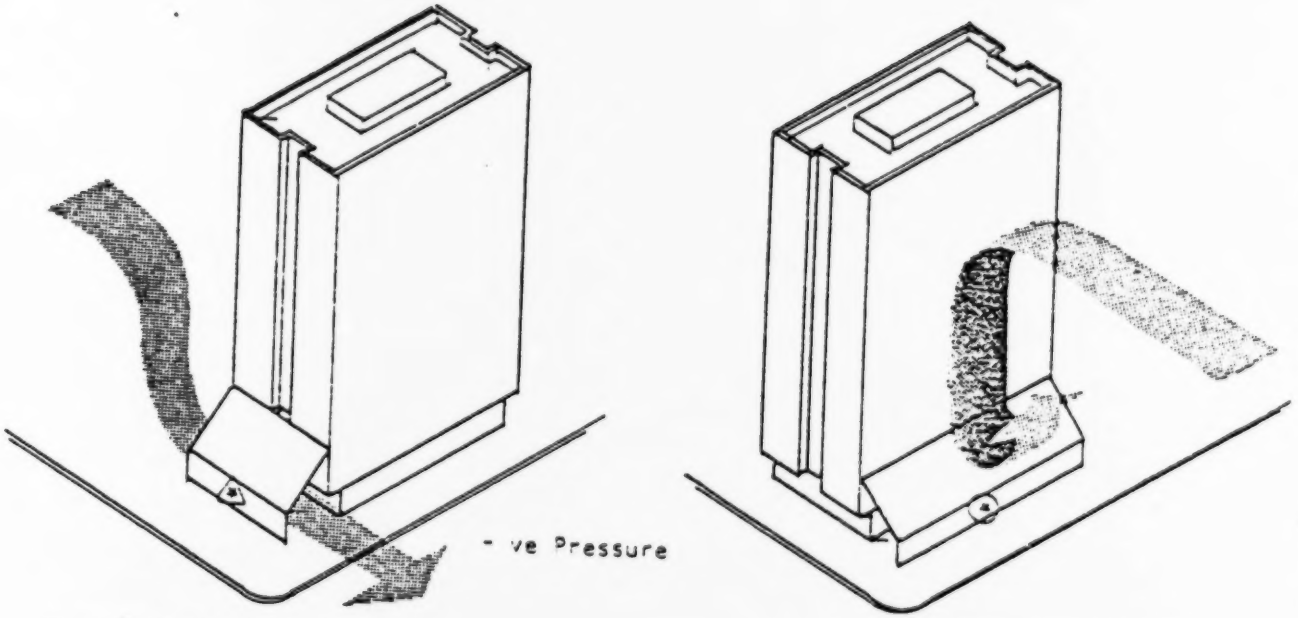
b) This creates a very severe pedestrian level wind condition.



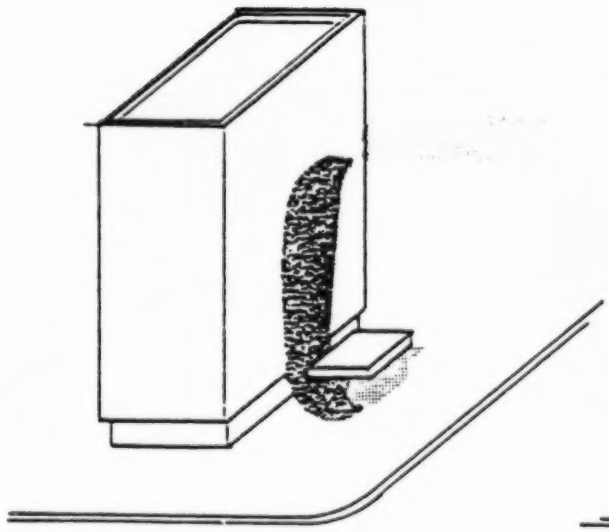
c) Locating a low rise building upstream of a highrise can cause more wind to be deflected down the face of the tall building.



a) Wind can also be funneled by relatively low buildings.

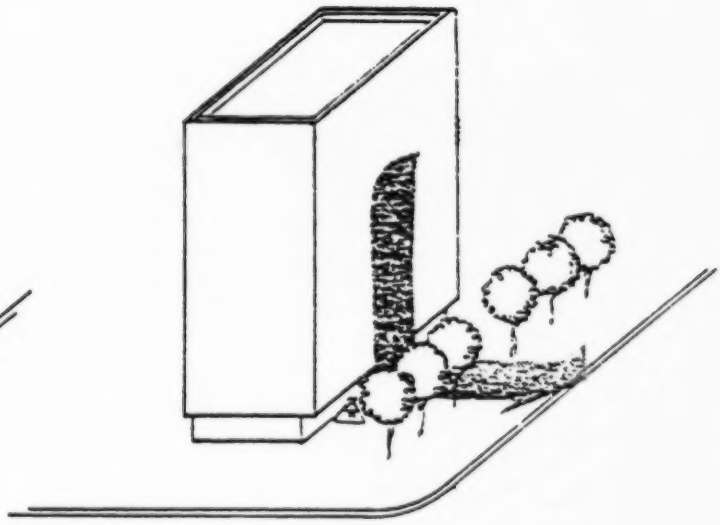


b) Enclosed passageways should connect areas of equal pressure.

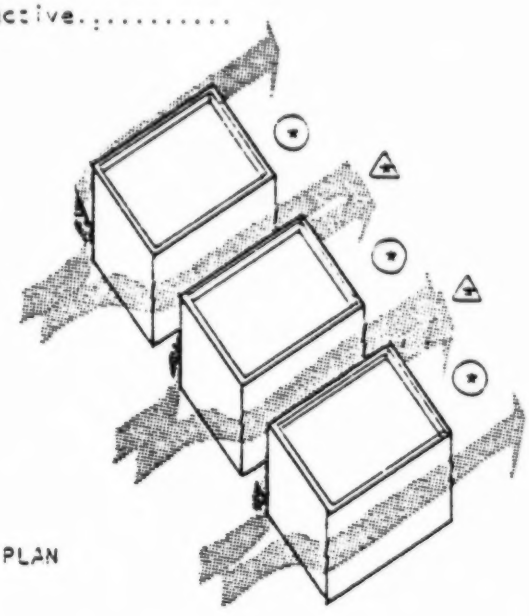


ELEVATION

a) A canopy which is not touching a building is ineffective.....



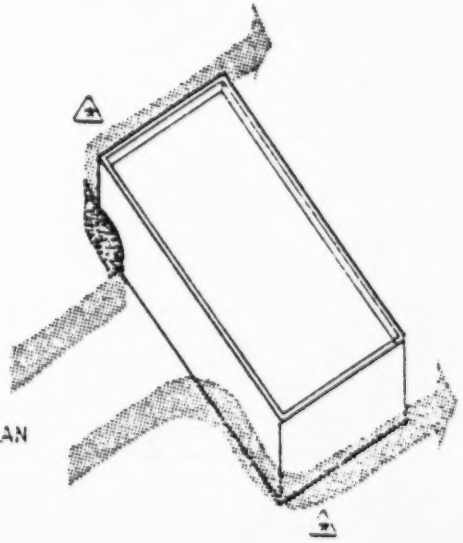
b) .....also landscaping



PLAN

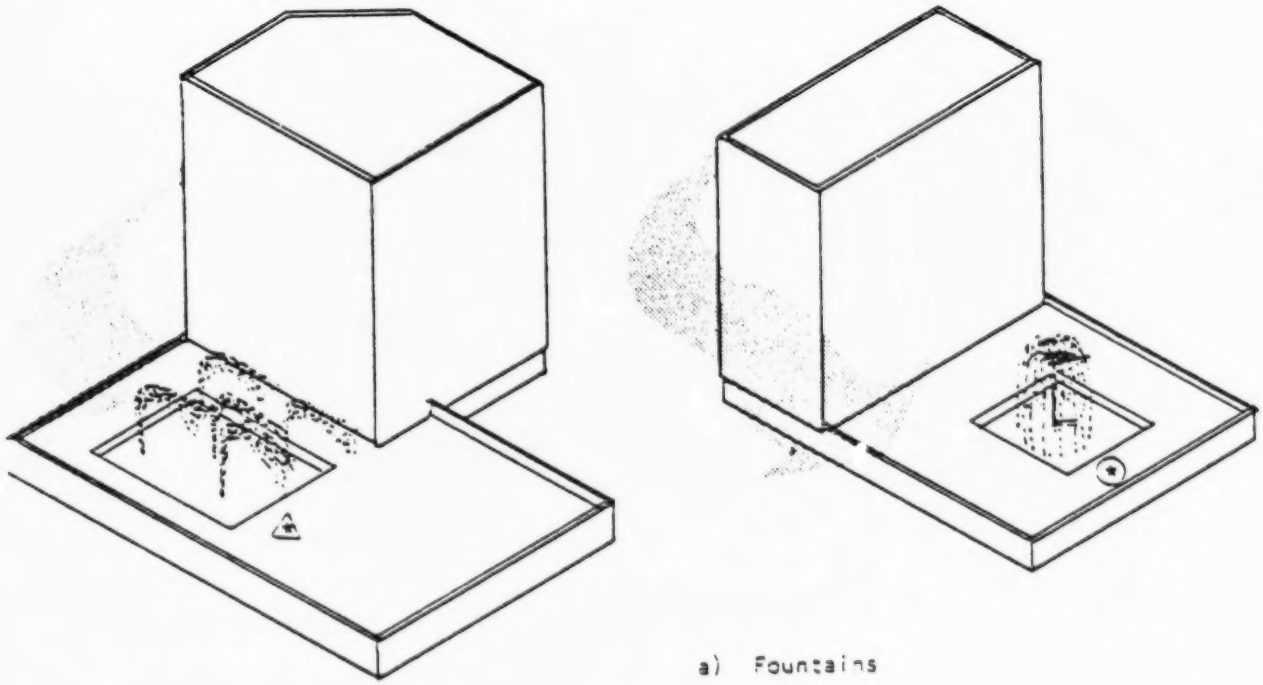
c) Produces an alternating calm/windy sensation - uncomfortable .....

BUT

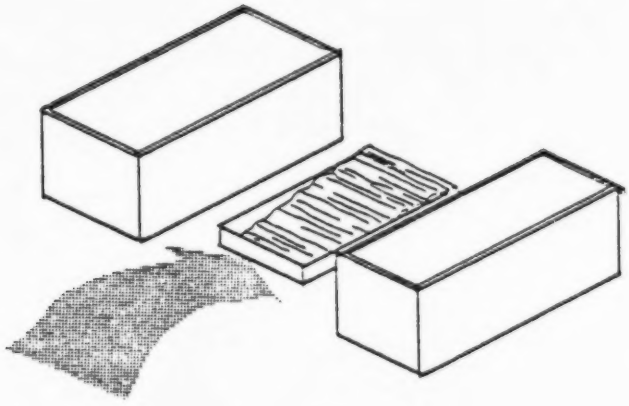


PLAN

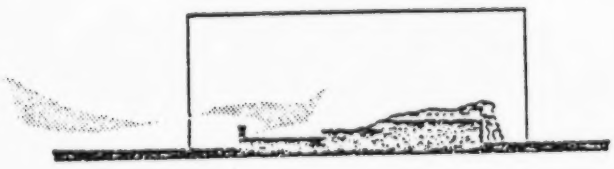
d) .... This produces relatively higher wind speeds.

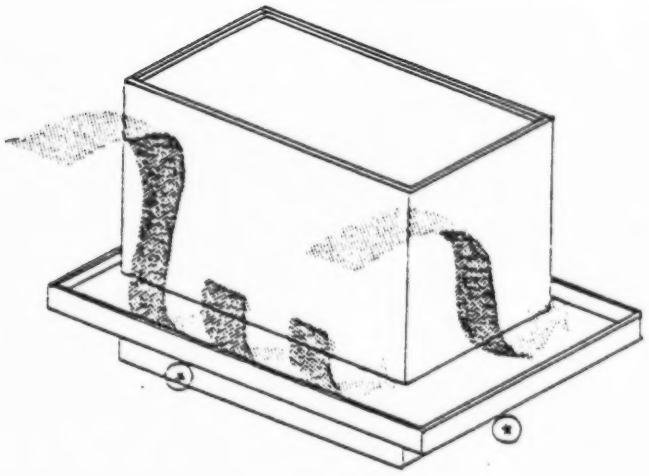


a) Fountains

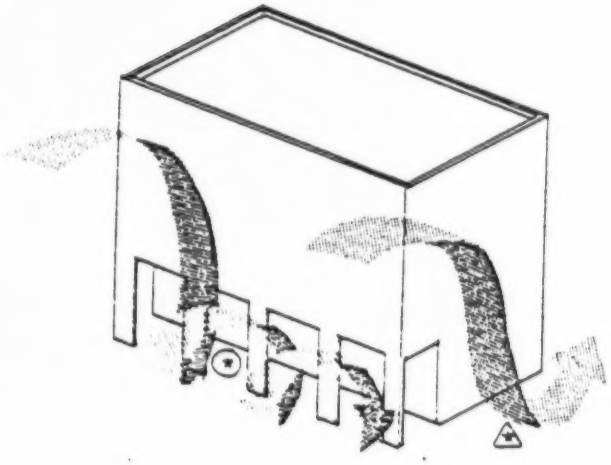


b) Ponds

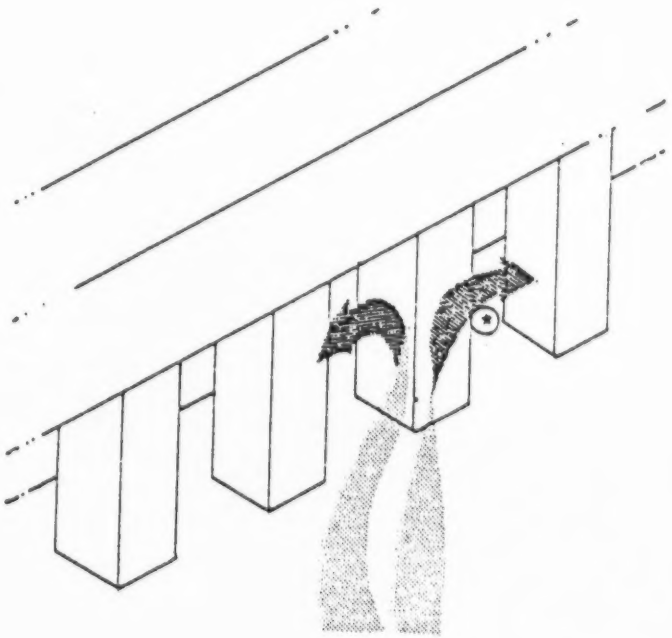




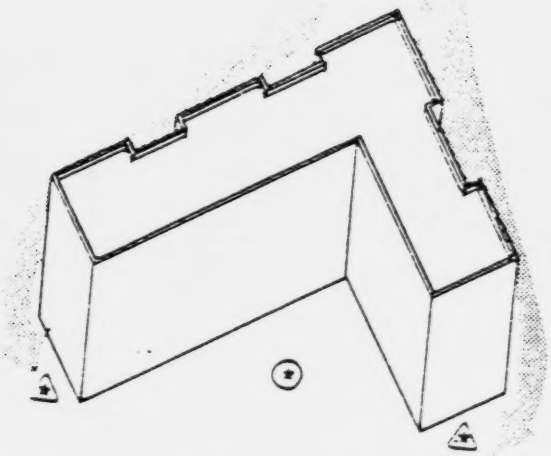
a) Canopies are beneficial on the windward face and should be continued around the building.
-- parapet walls assist



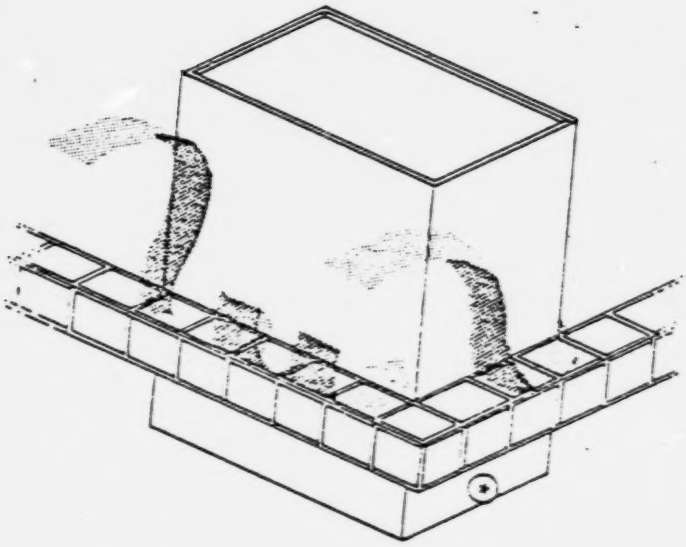
b) Arcades have a similar effect.



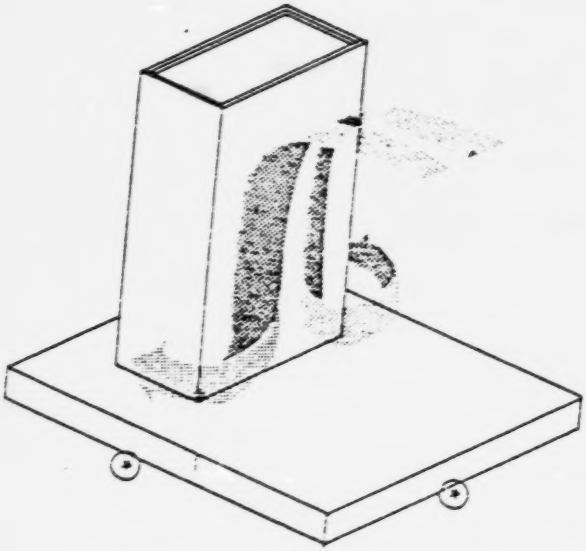
c) Large columns assist with angled flows.



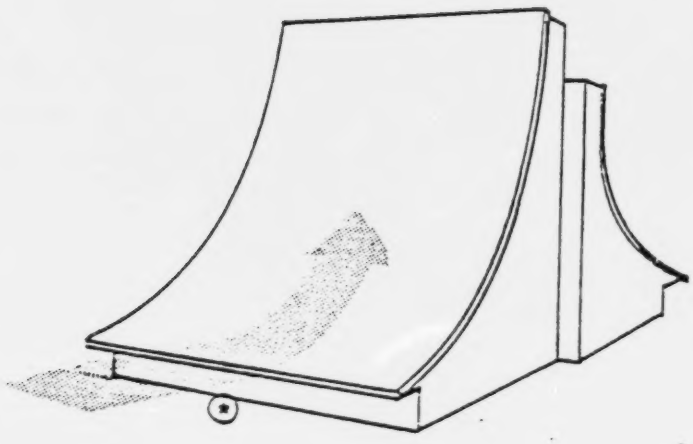
a) Building can be used as windscreens but pedestrian areas should be carefully selected.



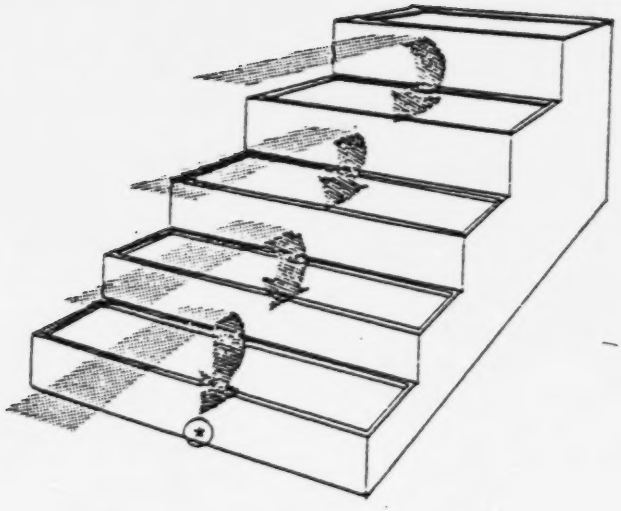
b) 45 feet level walkways can be used as canopies.



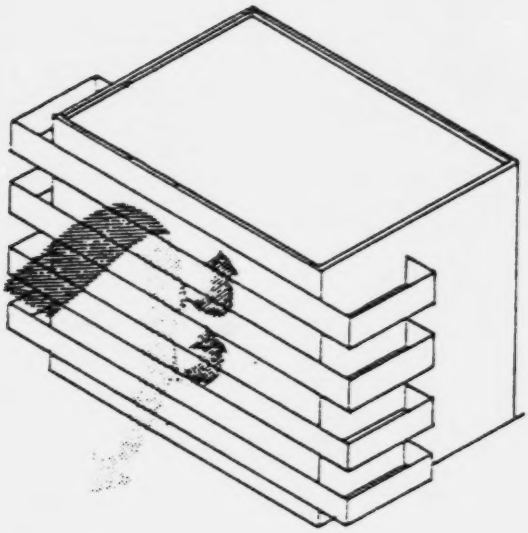
c) Non-pedestrian podiums provide comfortable walkways around tall buildings.



b) Curved faces can prevent the downwash effect.

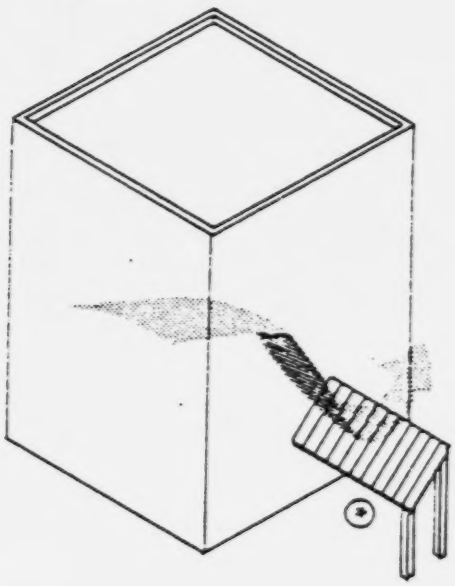


a) Stepped buildings will gradually break up approaching wind flows.

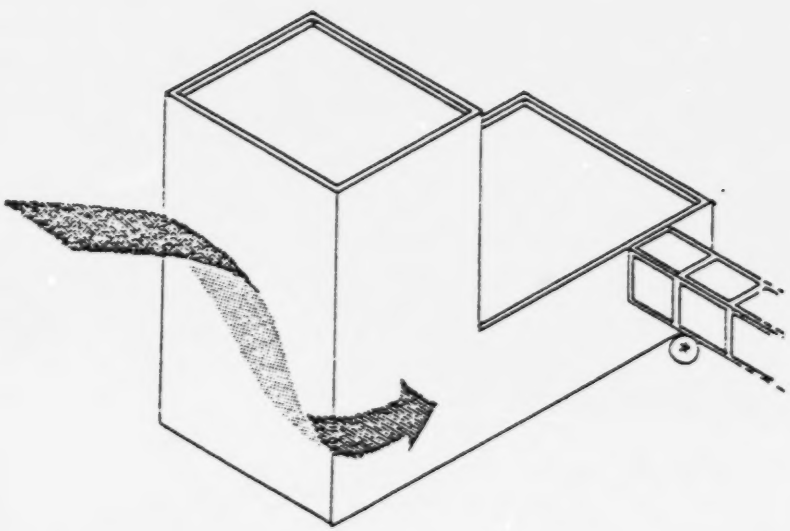


Elevation

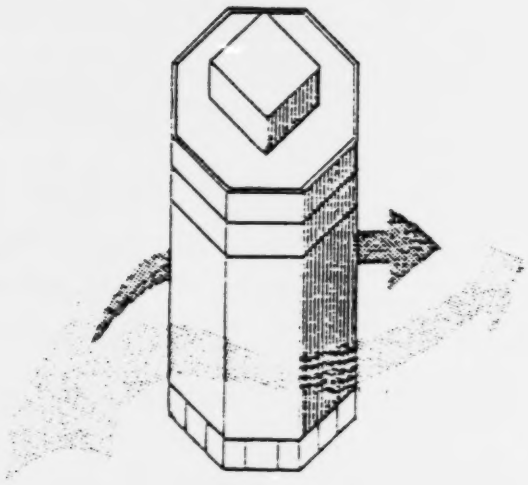
a) Balconies can minimize. but not prevent downwash.

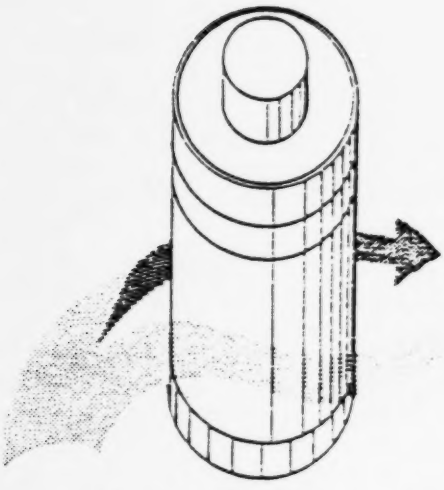


b) A wind deflector fin if carefully designed, can minimize corner wind flows.

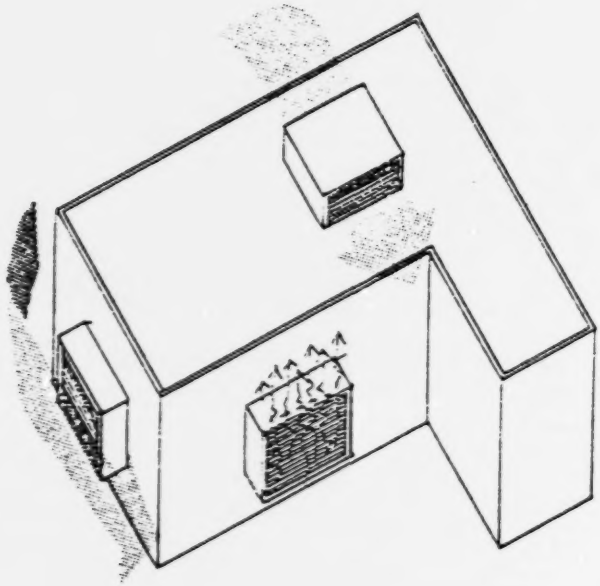


c) +15 feet walkways should be located away from increased corner flows.

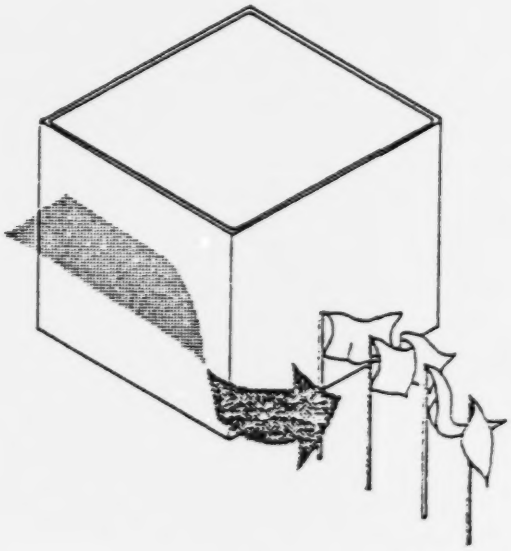




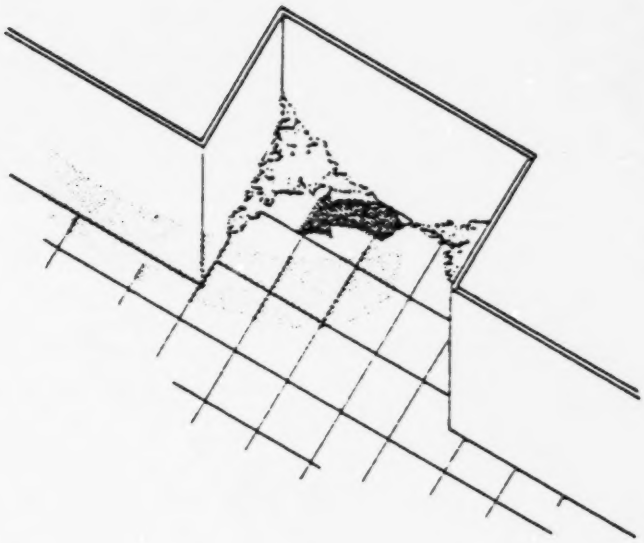
a) Round and hexagonal shaped buildings minimize downwash.



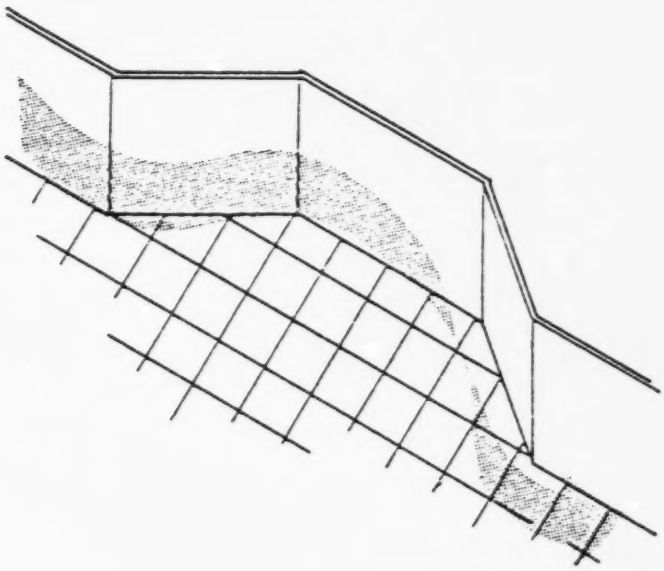
b) Locate mechanical exhausts in wind flows - not stagnant air regions.



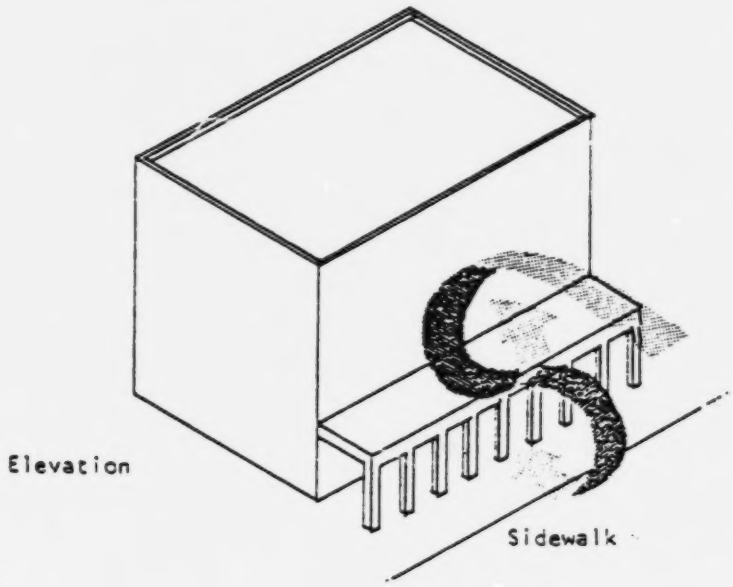
c) Provide public indicators of wind conditions in unavoidable high wind speed areas e.g. flags.



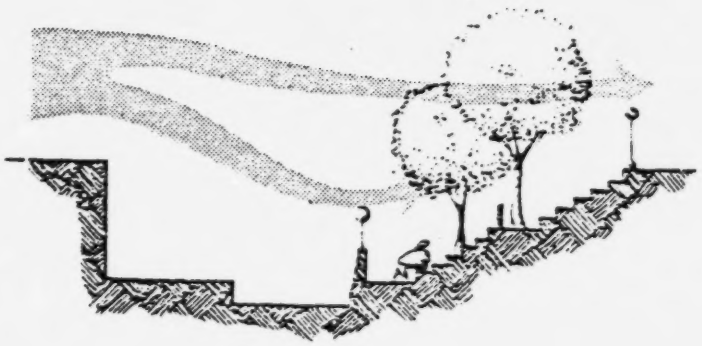
a) "Over protected" entrance. Recessed entrances with still air regions are potential snow collection areas.



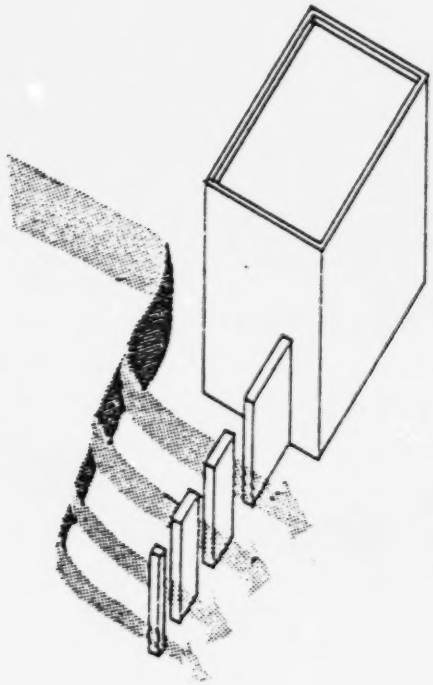
b) Scoured entrance.



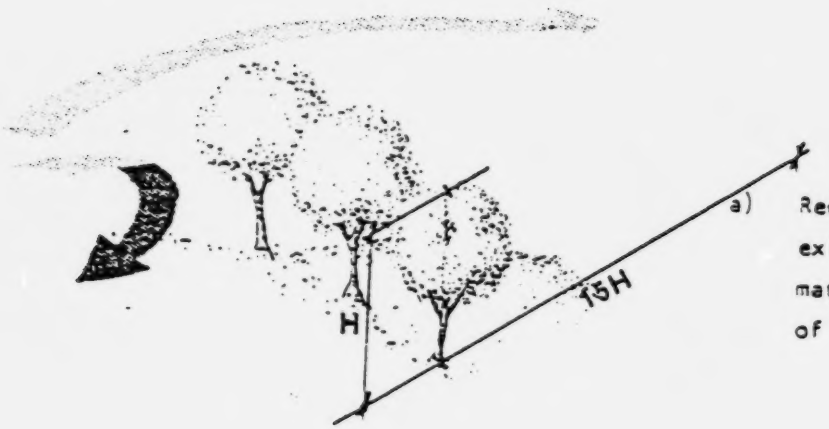
a) Give pedestrians a choice of calm or windy areas (breezes are welcome on hot days).



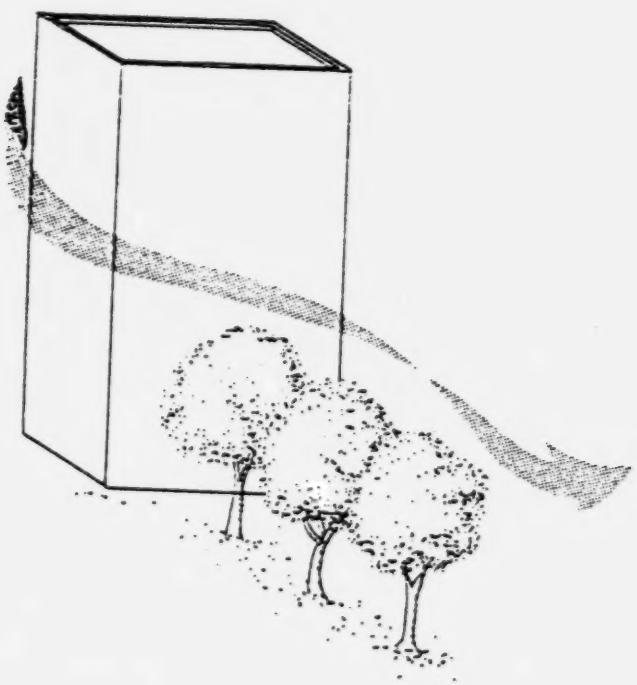
b) Recessed lounging areas are desirable.



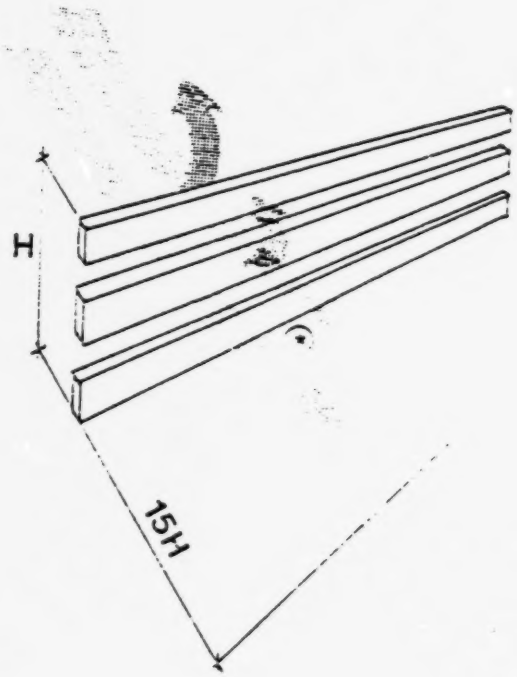
c) If a windy area is unavoidable, introduce pedestrian to the high wind speed area gradually i.e. baffles break up wind.



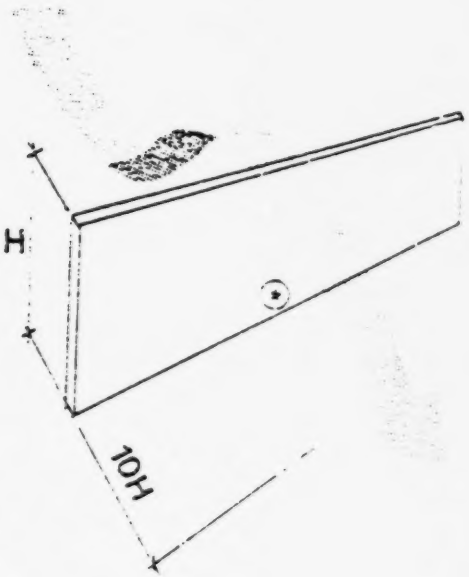
a) Reduced velocity area exists for approximately 15 x height of trees.



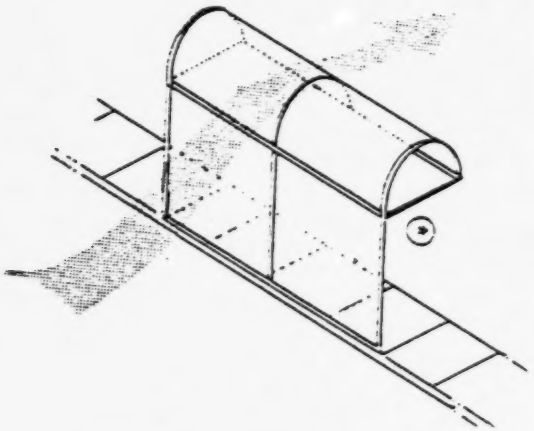
b) Downwash from a building can shorten this protected area.



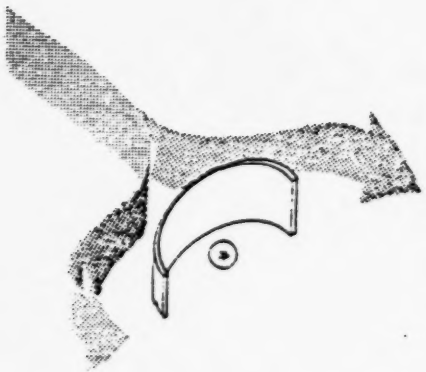
a) A 50% porous screen produces a reduced velocity area for 15H....



b) .... A solid fence for 10H.

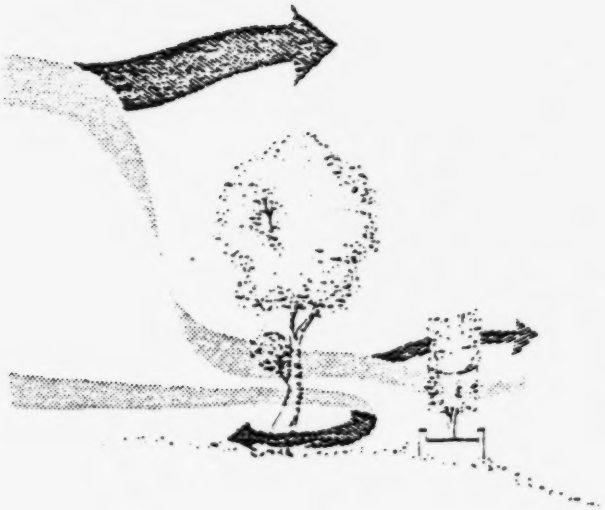


c) Partially enclosed walkways must be oriented considering the prevailing wind directions.....

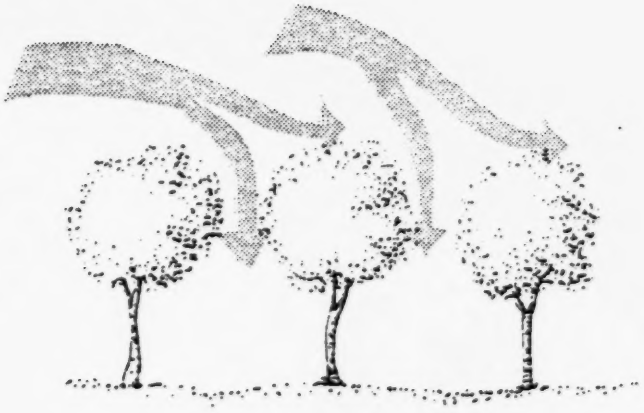


d) ....Also localized wind shelters.

a) Deciduous trees:- Often donot provide ground level protection - only provide protection during the summer months - are good for forming canopies to reduce downward wind flows.



b) Underplanting will assist in providing ground level protection.



APPENDIX C

Guidelines for Undertaking Pedestrian Level Wind Studies

APPENDIX C

GUIDELINES FOR UNDERTAKING PEDESTRIAN LEVEL WIND STUDIES

When a new building project is undertaken, consideration for any adverse wind conditions which may result from the construction of the building should be taken into account in the initial planning stage. Many uncomfortable wind conditions which exist in the vicinity of newer developments could be eliminated at the design stage if wind studies were undertaken. There are basically three different types of studies, as follows:

1. Wind Impact Statement
2. Massing Study
3. Detailed Pedestrian Level Wind Study

1. Wind Impact Statement

This type of study consists of an examination of the drawings of a proposed building and the meteorological data for the site. This data, coupled with the knowledge of general wind behaviour around buildings, is used to produce a written assessment of the potential wind environment around the proposed building. This type of study is sufficient when dealing with buildings up to approximately 15 storeys providing they have no novel design features such as a scalloped outer wall, walkways extending through the building, unusual width (i.e., greater than 75 m), heavily built-up surroundings, etc. A wind impact statement could be completed during the preliminary design stage of a project. Uncomfortable wind areas would be identified and some remedial measures would be recommended to reduce or eliminate any wind related problems.

2. Massing Study

A massing study should be undertaken at the early stages of design of a major project that includes one or more towers of greater than 15 storeys or includes many low-rise elements on the site. For this type of test, a scale model of the proposed development is constructed and tested in an open channel waterflume and a boundary layer wind tunnel. The primary aim of this type of study is to determine areas both surrounding and within the study site likely to experience uncomfortable wind conditions and suggest the optimum building form which will alleviate any potential pedestrian level wind problems.

Wind flow patterns in the vicinity of the proposed development are determined visually in an open channel waterflume. Once the wind patterns have been mapped, detailed wind

speed measurements are obtained at critical point locations around the proposed site in a boundary layer wind tunnel. This data is then used to determine which of the prevailing wind directions tested causes most high wind speeds. After identifying critical wind directions, the model is retested in the waterflume where the path of the approaching wind can be traced and either deflected, diffused or redirected away from the critical area. Recommended remedial solutions are in the form of the addition, subtraction or relocation of mass to effectively reduce or alleviate any potential uncomfortable wind situation.

For this type of study, a meeting with members of the design team is required during the design phase to illustrate the effects of the proposed remedial solutions. After this meeting, further testing would be undertaken in the waterflume to modify any solutions which were unacceptable.

3. Detailed Pedestrian Level Wind Study

Once the final massing of a building has been determined, a detailed pedestrian level wind study is usually necessary if any localized uncomfortable wind conditions still persist after the massing study.

For this study, a detailed scale model (usually 1:500) is constructed of plexiglass of the final design of the proposed building. Remedial solutions to critical areas are developed in a waterflume and tested in a boundary layer wind tunnel to determine their effectiveness.

The solutions are in the form of building details and/or landscaping which can be incorporated into the design without having an adverse effect on the architectural, functional or other aspects of the project. The model is tested for various wind directions with particular attention being paid to the prevailing wind conditions. A thorough examination is carried out of all areas that are considered critical such as entrances, plaza areas, walkways, pedestrian lounging areas, podiums, etc.

This study also requires a meeting with project representatives to illustrate the effects of the final remedial solutions. Further testing is conducted to determine alternatives to any solutions which are found to be unacceptable.

DRIVE

SASKATCHEWAN

ELEVENTH

AVENUE

STREET

STREET

STREET

STREET

CORNWALL

SCARTH STREET MALL

STREET

STREET

TWELFTH

AVENUE

ALBERT

McINTYRE

SMITH

LORNE

SCARTH

HAMILTON

ROSE

SASKATCHEWAN DRIVE

ELEVENTH AVENUE

TWELFTH AVENUE

VICTORIA AVENUE

STREET

CORNWALL STREET

SCARTH MALL

McINTYRE STREET

SMITH STREET

LORNE STREET

SCARTH STREET

HAMILTON STREET

ROSE STREET

BROAD STREET

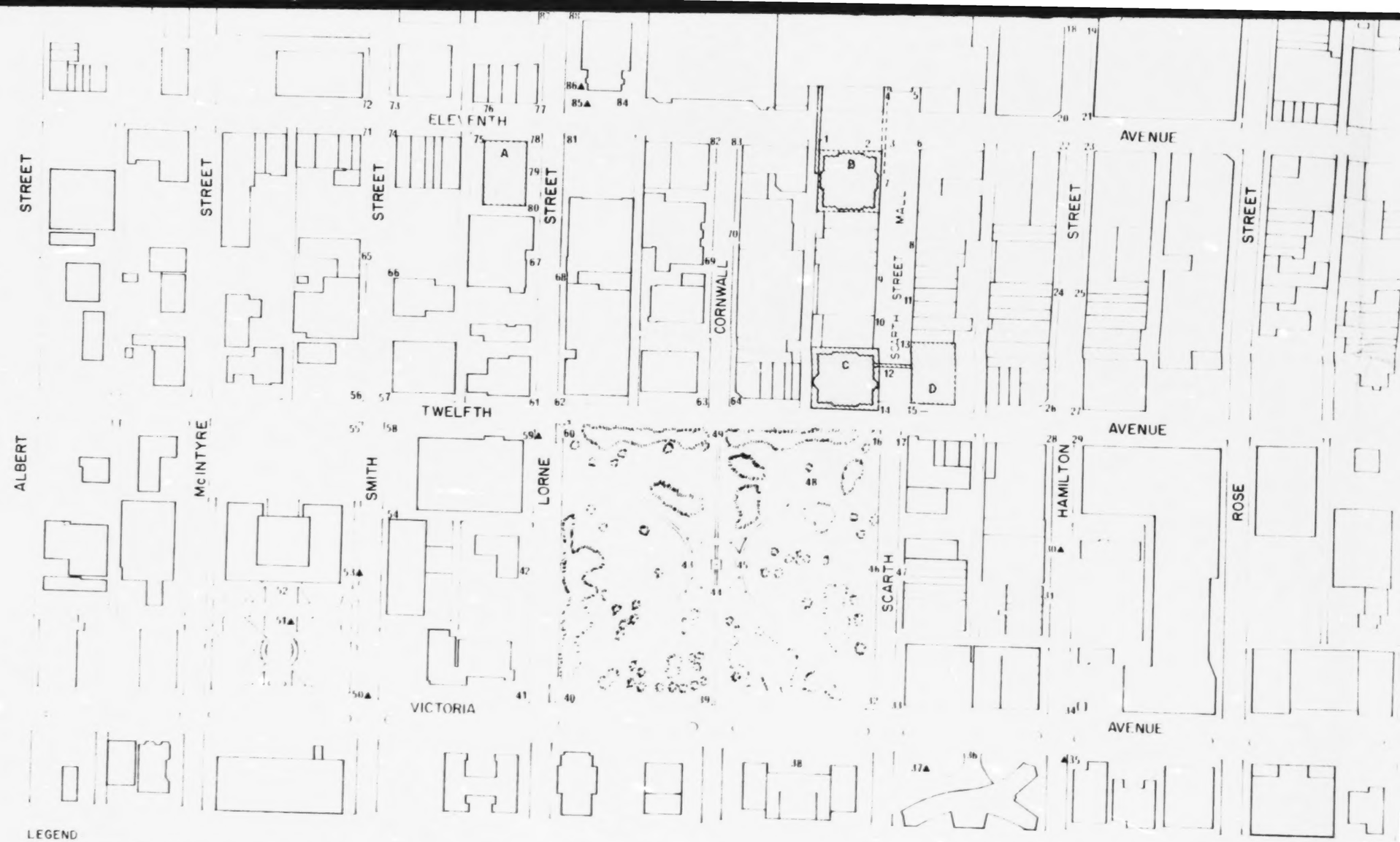
OSLER STREET

A

B

C

D



LEGEND

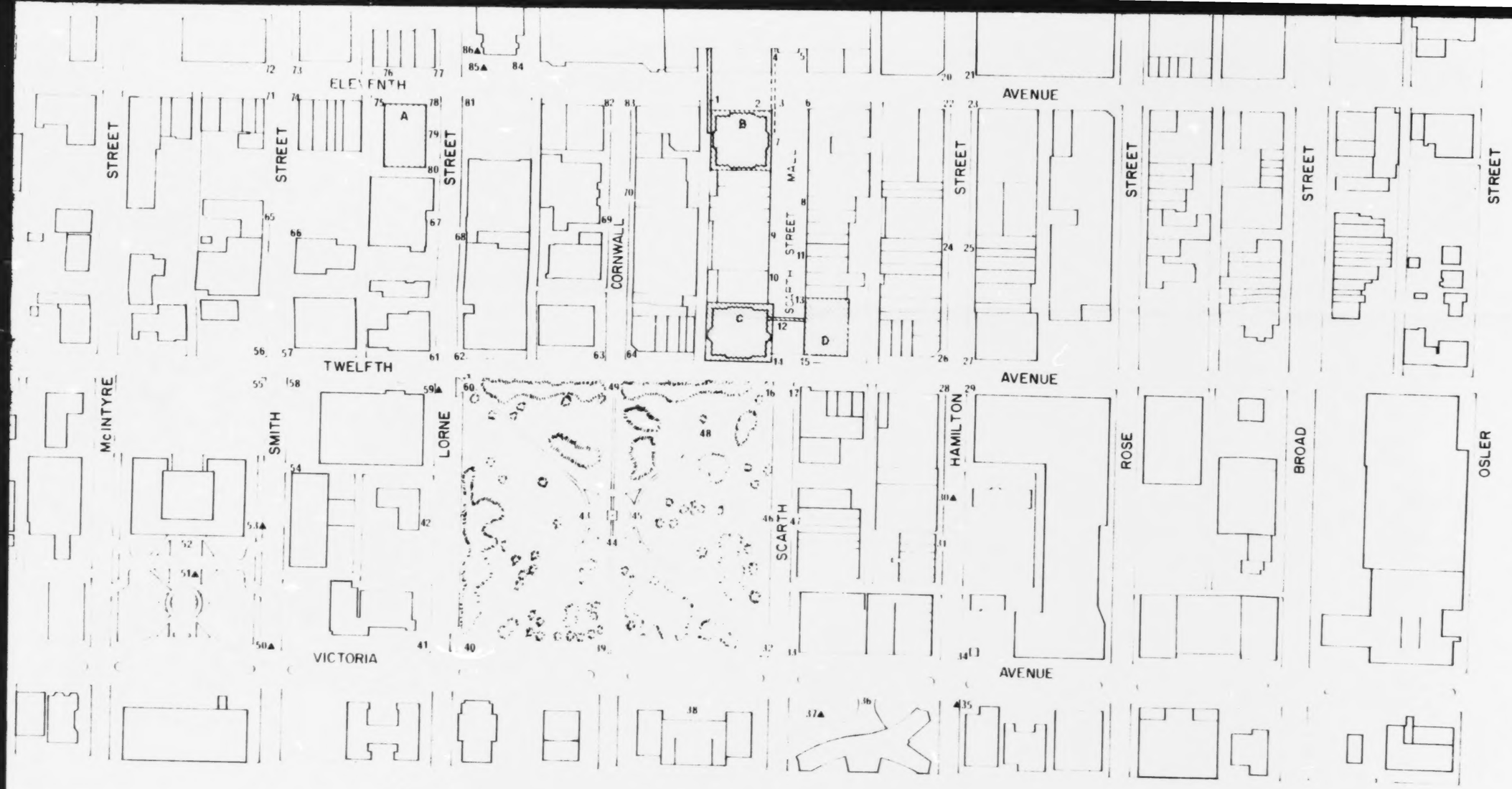
[ ]	PROPOSED DEVELOPMENTS	HEIGHT
	A LORNE STREET SQUARE	(50.0 m)
	B BANK OF MONTREAL	(52.1 m)
	C McCALLUM HILL	(91.4 m)
	D SOUTH EAST SCARTH STREET	(50.0 m)
▲	LOCATION OF SIGNIFICANT WIND ACTIVITY	
----	ALTERNATIVE LOCATION FOR ELEVATED WALKWAY	
1	NUMBERS INDICATE VELOCITY MEASUREMENT LOCATIONS	

Morrison, Hershfield, Theakston & Rowan, Limited
Consulting Engineers

CITY OF

DOWNTOWN

PEDESTRIAN LEV



OPOSED DEVELOPMENTS — HEIGHT

- LORNE STREET SQUARE (50.0 m)
- BANK OF MONTREAL (52.1 m)
- McCALLUM HILL (91.4 m)
- SOUTH EAST SCARTH STREET (50.0 m)

CATION OF SIGNIFICANT WIND ACTIVITY
TERNATIVE LOCATION FOR ELEVATED ALKWAY
UMBERS INDICATE VELOCITY MEASUREMENT OCATIONS

Morrison, Hershfield, Theakston & Rowan, Limited
Consulting Engineers

MHTR

CITY OF REGINA

DOWNTOWN CORE AREA

PEDESTRIAN LEVEL WIND STUDY

SCALE	: 1:2500
DATE	: 6/23/82
DRAWN BY	: RPC KW YC
PROJ. ENG.	: DJH
DWG. NO.	: 5821291

POOR

QUALITY

ORIGINAL